THE

AMERICAN NATURALIST.

VOL. XVII. — *FEBRUARY*, 1883. — NO. 2.

THE KINDRED OF MAN.

BY ARTHUR ERWIN BROWN.

MR. A. R. Wallace once called attention to the similarity in color existing between the orang and chimpanzee and the human natives of their respective countries. It would indeed seem as if but half the truth had been told, and that the comparison might be carried also into the region of mind; the quick, vivacious chimpanzee partaking of the mercurial disposition of negro races, while the apathetic, slow orang would pass for a disciple of the sullen fatalism of the Malay. Such, at least, was the impression left by careful observation of several specimens of each species which have been exhibited in the Philadelphia Zoölogical Garden.

A curious study are the moral qualities of the chimpanzee—for he has morals—not altogether such as would serve for the ordering of a human community, but very well adapted, seemingly, for his own needs. Watching them closely, in all their moods, all their passions, it was impossible to avoid the feeling that here was man in his primitive stage of moral development—" nature's ground plan" only—self-love predominant, the brute mainly, with but an occasional flash of the possibilities which the hand of nature was yet to shape.

"Adam" and "Eve" were both young, probably not more than three or four years old, and not half grown, as the chimpanzee is believed to require some twelve or fifteen years for the completion of that stage of existence. They were about the same size—perhaps they were twins—they had no family Bible to settle the question, but the extraordinary likeness between them was strongly in favor of the supposition; indeed, if Adam had

not been ornamented with a black smudge across the nose, they could hardly have been told apart; but twins or not, they loved each other with a most devoted affection, or, at least, so it seemed, but subsequent events cast a doubt on the real depth of their feelings.

Being young they were eminently social, for it may be said that as a rule, among wild animals, moroseness and ferocity come only with age. When they were first coaxed out of their traveling cage they were visibly embarrassed, and retired into the nearest corner, locked tightly in each other's arms, which, as we afterwards learned, was a universal refuge in time of doubt, but it was not long before they began to feel at home, and thenceforward were always ready to make friends with anybody who made his approaches in due form. As has been said, they were very fond of each other, and it was on rare occasions only that they were not clasped in a fond embrace, and not once during their life in the garden was anything but the most perfect accord manifested between them. No pretence of partiality in feeding, no petting of one to the exclusion of the other, could excite a trace of jealousy; the slighted one would simply retire to a corner and sulk, but their mutual relations were undisturbed; resentment was all towards the giver, not to the one who received. Each was at all times ready to stand by the other; probably the keeper has not yet forgotten the ferocious assult Eve once made on him from the rear, while he was engaged in pouring a dose of medicine down the throat of her companion.

Their anger was something ludicrous; the male especially was liable to paroxysms of rage, during which he would tear his hair with both hands, hurl himself down on the floor with a perfect tempest of yells and roars, but in a moment it was all over, and he was ready to make peace and accept any small attention by way of *amende.* But his masculinity asserted itself more particularly when danger seemed to threaten—then he was grand; advancing inch by inch, brandishing his arms, stopping after each step, with a stern frown, to emit a terrifying roar, he seemed an impersonation of resolution and defiance—a very Ajax—but after all, he was only a Thersites, a more arrant little coward than he, at heart, had never lived, and if his appearance did not have the desired effect, if the intruder stood his ground, the dignified approach gradually became slower, the resolution ebbed away, and the inevitable end

was a final stop, a hasty turn and an ignominious flight into the corner—generally, it is painful to say, behind Eve. We could only blush, we dared not blame him ; one nearer to us far than he, his namesake, under circumstances which brings the action home to each of us, had done the same.

Many experiments were made to test the mental capacity of these animals, with quite fruitful results; the primary mental operations, and even some which involved a greater or less combination of ideas, were performed by them with facility; indeed, it may be doubted if the undirected efforts of a human child of the same age, ignorant of language, could produce results of a much higher grade.

A mirror being placed in the cage, the male, after cautiously investigating the figure reflected, turned it over, and finding nothing but bare boards, he placed it face downwards on the floor and executed a sort of war dance on the back. Having repeated this a number of times, the glass was held firmly before him ; he then gave it more attention, at first attempting to drive away the figure he saw; at last a resemblance seemed to strike him, and after performing a variety of antics, seemingly for the purpose of comparison, it was quite evident that he became aware of his own identity—and in this, perhaps, afforded a trace of that self consciousness which conservative philosophy allows only to the lordly intellect of man. In this case it is probable that he had become accustomed to see a faint image of himself reflected from the glass front of his cage.

Perhaps, though, the most striking evidence of their power of reasoning was given when a dead snake was taken into the room and shown to them. As is well known, monkeys have an intolerable dread of snakes, and these were terrified beyond measure. They fled at once to the highest point of the cage, uttering their expressive cry of fear, and there they remained for hours, refusing to come down even at sight of their accustomed dish of food, and when at last they did so, it was with the greatest caution ; a slight movement in the straw covering the floor, was enough to cause a panic, and it was some hours before they fully recovered equilibrium. Finally, when both were sitting quietly near the glass front, the snake was suddenly shown to them on the outside, but there, the object which had caused such terror in the same room, was powerless; the glass which they themselves could

not pass, was a barrier as well to their enemy, and they simply sat still, pointing at it with their fingers and uttering the *hoo-hoo* which expressed doubt, dislike and disgust. It was suspected that they had only become accustomed to the sight, and to complete the experiment the snake was again thrown in through the back door, when the terror of the two animals was as great as on the previous occasion.

It was quite clear that they possessed a limited means of vocal communication. Sounds, to the number of three or four, were uttered by one, which met with a different response from the other, either by voice or action, and in which it was quite possible for the human ear to detect a difference.

The imitative habits common to the whole tribe of monkeys were strongly marked in them, and made it relatively easy to teach them to use a spoon or drink out of a cup, and to perform various small tricks. In cleaning the glass in front of the cage with paper, the keeper generally threw two pieces on the floor beside him, when each chimpanzee would take one of them and set to work polishing the glass in like manner, deriving, apparently, great satisfaction from the performance. The delicacy of their taste became developed to an extraordinary degree by the varied diet afforded them ; both were fond of the taste of sherry, which was always put in their tapioca and cornstarch, but when brandy, whisky and rum were substituted, they stuck out their under lip in disgust and refused to eat it.

For music they had no ear whatever; the notes of an accordeon and violin produced in them only distrust of the instrument, and when these were put into their hands, their insatiable curiosity prompted only efforts to find out what was inside.

For many months Adam and Eve were the pets of the " Zoo;" few days there were when they were not surrounded by a crowd of interested spectators, some of whom, to a critical eye, were fully as amusing as the animals they came to see.

It is learned from African travelers that the native tribes inhabiting the range of the gorilla and chimpanzee believe them to be human beings who have degenerated from their original state, and that out of pure laziness they refuse to speak, in the fear that if their possession of the faculty should become known, they will be set to work in the fields; indeed, the native name of the chimpanzee, *Enge-e-co,* means "hold your tongue," and evidently

originated in this belief. It frequently seemed as if similar ideas prevailed among a certain part of the visitors, and that class especially whose acquaintance with the forms of orthography had not reached a familiar stage, seemed to find in the scientific name of the animal, *Anthropopithecus niger*, indications of a relationship to the humble man and brother whose ancestors sprang from the same soil.

But at last, in spite of tender care and attention, Eve became sick—poor little thing, how she did suffer. Of course she ought to have been a good and grateful patient and have known that everything done for her was for her ultimate benefit—they always do in the animal literature of the day—but she had read little, and so was hardly to blame in following out the instincts of her nature. She might have been expected to look appealingly into the eyes that bent over her, but she did not; she ought to have pressed affectionately the hand that cut the hair from off the region of her little stomach and gently applied a mustard plaster to the affected part, but instead, she bit it savagely; and to crown all, she was so little sensible of the soothing influence of that mustard plaster that it took the united efforts of three men to keep it in place until its work was done.

Alas for all the works of fancy! a long experience of sick and suffering animals compels the conclusion that one of the things which is beyond the grasp of mind to be found among the lower animals, is surgery.

And so Eve passed out from the familiar places of the "Zoo." Her funeral urn stands ranged on a shelf in that universal mausoleum of nature, the Academy of Natural Sciences, and her "In Memoriam," by Professor Chapman, was published in the Proceedings of that venerable institution.

Adam was left alone to mourn, but to his shame be it said that although he was inconsolable at first, so long as the dead body of his late companion was in sight, he soon got over it, and in forty-eight hours not a trace of her seemed to exist in memory, excepting that to the day of his death, some months later, he was afraid to sleep alone on the floor, where the two had always slept together, and with the shades of night he followed out his ancestral habit, climbed as high as he could get towards the roof, and there composed himself to peaceful slumbers.

For some time the garden was without any specimen of the

higher apes, until in the autumn of 1879 a young orang-utan was safely received.

There is something about the orang that irresistibly suggests a spider—one of those red, hairy, long-legged spiders which one sees with an instinctive feeling of repulsion. At no age can the animal be called handsome, and the old males, covered with coarse, reddish-brown hair six or eight inches long, with a huge protruding jaw and a mass of hardened skin on each cheek, are about as unprepossessing as anything that nature has produced. "Topsey," however, as is sufficiently indicated by her baptismal name, belongs to the fairer sex; her age—probably for that reason, is unknown. When she arrived she was supposed to be about two or three years old, but as the lapse of time has made hardly any change in her personal appearance, save in the way of *embonpoint*, it is probable that she was older, although she is certainly not half grown; if, indeed, as has been suggested, she may not be a dwarf—a sort of feminine Tom Thumb among orangs; and in this, possibly is the explanation of the unusually good health which she has enjoyed through a lifetime much longer than is common to her species in captivity. The amount of nutrition required to simply maintain the existing condition of body, would of course be less than if the processes of growth were in full activity, and the assimilation of food, which is probably defective in most caged animals, would, as has been the case here, be sufficient to keep her in good condition.

Between the orang and chimpanzee there is a marked difference in moral qualities. The latter is full of life, vigor, vivacity; lively and child-like in disposition, enjoying life to the full, and taking interest in all that goes on about it. Quite the reverse with the orang—it is slow, sluggish and calculating; philosophically indifferent to everything but its immediate wants—voluptuary and stoic in one—life is only for the means of living, and life itself is hardly worth the pain of an exertion. It is exasperating—the apathy of the orang; for hours it will lie wrapped in a blanket close to the front of the cage, lazily following with its eyes the motions of any person who comes within its range of vision, or slowly blinking at a straggling fly upon the glass, moving—when it must move—only with the greatest deliberation. If left hanging by one hand to a rope or branch, there it will hang, perhaps for several minutes, before making up its mind to take hold with the

other or let go altogether. Latterly the contrast in the disposition of these animals has been made very striking by the presence in one cage of specimens of each species. A second pair of chimpanzees, about the same size as the orang, were placed with her, and with their natural liveliness at once made overtures of acquaintance, which were as promptly repulsed, and during the first week she suffered so much fright and uneasiness from their perfectly good-natured attempts to induce her to join in their play, that it became necessary to partition off with wire screens a corner of the apartment, and there, hour after hour, while the two chimpanzees are climbing, swinging and tumbling about the cage, never at rest except to plan some new scheme of amusement, the orang lies flat on her back, fingers and toes closely interlocked in the air, enjoying a *dolce far niente*, the relish of which she seems to intensify by quiet wonder at the reckless prodigality of force indulged in by her neighbors.

This stolidity is characteristic of the species in a wild state; there they live mostly in the tree tops, cautiously crawling from branch to branch, testing every limb before resting their weight upon it, moving only to satisfy the demands of hunger, and when that stimulus to action ceases, subsiding into a half-sitting position with the trunk or branch of a tree to hold up the back, head bowed on the breast, hands hanging down—not asleep—it can be nothing but laborious thought that produces such perfect bodily repose. Who can tell how deeply the meditative orang has penetrated into the mysteries of the cosmogony of which he is a part? how many systems of philosophy have dawned, after hours of reflection, into his weary brain? how deeply he has pondered on the origin and destiny of his race, and to how many metaphysical final causes has his speculative career traced its way?

The orang is really not so stupid as appearances would have it, and it is an interesting fact that the actions of the one in question once gave evidence—and the only evidence the writer has ever observed among the lower animals—of what seemed to be some understanding of death. Another orang had been procured as a mate, and arrived in bad health; it was exceedingly irritable, and though weak from disease, managed to appropriate the only blanket in the cage, and fought off the rightful proprietor whenever she approached. This, with other grie-

vances, caused Topsey to regard the intruder with marked dislike and fear. She watched it from a distance all through the several days of illness, and the more attentively as the last moments drew near and pain and weakness were showing plainly their ravages, until finally, after a hard struggle, the little sufferer lay motionless and dead, then, for the first time, she drew near, looked at the body for a moment, pushed it with one hand, and then after putting her nose close down against its face, as if to listen for a breath or any sign of life, she began pulling from under it the coveted blanket which it was no longer able to defend, and in the most satisfied manner wrapped herself up and laid down in peace.

Much less opportunity has been afforded for critical observation of the remaining anthropoids—the gorilla and the gibbons—as few of either have been kept in captivity; but the former may fairly be considered as not presenting marked mental differences from the chimpanzee, and the latter seem in all respects to be below the level of the others.

In considering the proper station of man and these animals in the zoölogical system, a brief glance must be given at the other members of the order to which they belong.

Three remaining families complete the group of Primates: the Catarrhini, embracing all the monkeys of Africa and Asia, and the Platyrhini, inhabiting tropical America and the West Indies. Beside these are usually included in the order, the Lemurini, a large and ill-assorted group known also as Prosimiæ or half-apes, all of which fundamentally are of the monkey type of structure, but many forms of which partake also in the characters distinctive of bats, rodents and insectivores. The two groups of old and new world monkeys are very well distinguished by anatomical peculiarities; thus in the Platyrhine group the nostrils are far apart and look almost directly forward; there are no cheek pouches for the stowing away of food, nor any of the brightly-colored callosities on the haunches, which are common to many of the others; all the American monkeys have long tails, which in many species are strongly prehensile and serve almost the purpose of a hand, while in all of Africa and Asia not a prehensile-tailed monkey is known, and a number of species, including the higher apes, have no tails at all; in this group, too, the nostrils are close together and look downward. The number and arrangement of teeth cor-

respond to that of man, while the greater part of American monkeys have two more teeth in each jaw, and in those which do possess the same number the arrangement is unlike. Geographically and structurally the apes we have been describing belong to the old-world group, and geographically and structurally, too, man's alliances make it necessary to consider him a member of the same family.

But though it is assuredly no part of the writer's purpose to belittle the evidences of this genetic connection, the candid acknowledgment must be made, that a somewhat undue prominence has been given to the anthropoid apes in this respect—although probably more in popular misconception of what men of science have written than in anything which the writers themselves have intended to convey.

The points of resemblance are many and close, but the category contains many in which each ape stands closer to man than do any of the others, and there are as many more, perhaps, in which similarity is found, not among the higher, but in some of the lowest of the monkey tribe.

A full list of the points of close alliance would be far longer than the purpose of this paper demands, and it will be sufficient to mention a few cases of resemblance and of difference, simply to indicate the complex nature of the relationship.

The gorilla resembles man most in actual bulk, in size of the brain, in proportional length of the hand, and of the thumb and great toe to the spine, of the two segments of the arm to each other, and in the presence of the transversus pedis muscle; but he has no flexor longus pollicis in the hand, no plantaris and no flexor accessorius in the foot, both of which are found in man and most of the lower monkeys.

The chimpanzee is man-like in shortness of arms compared with the spine and with the leg, in many details of brain structure and in the possession of a palmaris longus muscle, but the plantaris, the transversus pedis, and sometimes the flexor accessorius are absent, and the flexor longus pollicis is variable.

The orang excels in the proportion of hand to foot, in some details of the pelvis, and in general brain development is, perhaps, higher than either of the others; it also has the palmaris longus and a part only of the flexor accessorius, but the flexor longus pollicis, the plantaris and transversus pedis are absent, and

the flexor longus hallucis belies its name by giving no tendon to the great toe.

In the form of the larynx, one of the gibbons comes quite near man, but in other respects is less like him than the other apes.

The chimpanzee and gorilla, like man, have eight bones in the wrist and ankle, while the orang has one additional in each; the human number of twelve ribs is found only in the orang, but to more than offset this, it has in the foot a special muscle, the opponens hallucis, making of the big toe almost a thumb, and of the foot almost a hand—a degraded structure which is not known in any other monkey nor in man.

A close approach to the human form of teeth is found in the anthropoids, but for the reduced size of the canines, the absence of a space both in front and behind each canine, and in some details of the grinding surfaces of the molars, a parallel is found only in some South American monkeys and in one of the lowly-organized lemurs.

The orang and gorilla have the same number of spinal vertebræ as man, but in the curves of the backbone which they form, and which are vitally important to his habitual attitude, the baboons bear a closer resemblance. So, too, with the position of the occipital foramen in the base of the skull, enabling the head to preserve a balance on the vertebral column—a necessary condition of an upright posture—and in the cranio-facial angle, a similar gap between man and the anthropoids, with a closer approximation on the part of some of the lower forms, may be traced.

Owing to the articulations of the tarsal bones, no animal but man can habitually walk erect, and the apes can approach such a position only with the help of some external support; the gorilla, chimpanzee and orang all walk by touching the ends of the fingers or the knuckles on the ground, and in the gibbons the arms are so long that the animal swings itself between them as on a pair of crutches. Some of the South American monkeys, however, notably those of the genus Ateles, are able to walk erect on the hinder extremities for a considerable distance, the long tail serving, to some extent, to preserve the balance.

It has been asserted and maintained by a number of European anatomists, against the venerable authority of Professor Owen, that in the anthropoid brain, the backward projection of the posterior lobes of the cerebrum overlap and completely hide the cere-

bellum from view, when looked at from above, as is the case in man—an almost steady progression from the lowest types of brain towards this arrangement, being found throughout the mammalian series. It must be said, however, that in three chimpanzees from which the brains were removed a few hours after death, by Professor H. C. Chapman and the writer, in spite of preconceived notions, this was found to be clearly not the case, and in the orang, the cerebellum was covered to a very slight extent only, posterolaterally. There are few of the lower monkeys, however, in which the man-like relation of these parts does not exist, and in one, at least, the squirrel monkey (Chrysothrix) of South America, this posterior projection is even greater than in man himself.

Observation renders it quite probable that mental capacity in these animals has, to a considerable degree, maintained a relation to the complexity of detail in brain structure, although undoubtedly, from a mere comparison of human and anthropoid brains, a far greater degree of intellectual power than that which really exists, might be expected from the latter; it should be remembered, however, in favor of the ape, that the specimens from which our ideas of their intelligence have been derived, have for the most part, been very young, and it is possible that more mature age may bring with it a higher degree of mental faculty. On the whole, however, it is quite certain that the intelligence of the lower animals has been greatly overestimated. All experienced observers of their actions know how easy it is to place a motive and an understanding where none probably exist. It is difficult, except after long training, to withstand the influence of the subjective tendencies of the mind, which lead the observer to translate into the terms of his own intelligence, those actions which seemingly correspond to his own desires, and there are few works on this subject in which constant evidence is not given of its presence. In experimenting with the animals which form the subject of this paper, the difficulty was constantly met with, and a large proportion of the phenomena observed were set aside, reluctantly in many cases, because of the doubt.

In the slow development of anatomical structure, the presence or absence of a single bone or muscle must be of vast importance in working out the pedigree of an organism, and enough has been said to show how varied are the directions in which man's alliances seem to point.

It is held generally, in popular misconceptions of the doctrine of evolution, that man is a direct descendant of the higher apes, and the gorilla is commonly looked on as being his nearest progenitor. From the standpoint of science, however, no student of biology will maintain that the ancestry of man has yet been fully traced, but will limit himself to the conviction that at some period of the prehistoric world, the forces of nature, acting from without, on the plastic materials of life, have brought down from an unknown point of departure—perhaps among the lemurs—two diverging lines of development, one of which finds its present type in man, the other in the Catarrhine monkeys and their highest form—the anthropoids.

Perhaps the future of science may unfold the details of development, but to do this it is probable that ages of geological upheaval will be required, to bring above the ocean continents long buried, in which the process took place and in which the records are contained.

Manlike as are the apes, there is a contrast which the resemblance serves, in great part, but to intensify—anatomy finds similarity throughout and takes note of little that is unlike, while function, based upon these structures, has become so specialized and elevated during progress from the lower to the higher, as to become almost difference, and man and ape are in fact as in time separated by a gulf so vast that the furthest reach of science can catch, as yet, but shadowy outlines of the other side.

——:o:——

INDIAN STONE GRAVES.[1]

BY CHARLES RAU.

THERE seems to be a rather general impression that the so-called stone graves, so frequent in some States of the Mississippi valley, belong to a remote period—at least to a time long anteceding the arrival of the whites in North America. No doubt many of these graves are very old, as is shown by the appearance of the bones they contain; but to others a more or less recent date must be ascribed, and there is even evidence that the practice of constructing them had not yet ceased in the present century. I purpose to furnish that evidence in this paper.—

[1] Read at the Montreal Meeting of the American Association for the Advancement of Science, August 25, 1882.

A very good account of an exploration of stone graves in the neighborhood of Prairie du Rocher, in Randolph county, Illinois, was given, many years ago, by Dr. A. Wislizenus, of St Louis.[1] He examined eleven of these graves, which he describes in proper succession, closing with a résumé of his investigation. "The general construction of these graves," he says, "is coffin-like, their side-walls, top and bottom, being formed by flat limestones, joined together without cement. The size of the graves was adapted to that of the persons to be buried in them. We find them, therefore, in length, from 1½ to 7 feet; in width, from 1 to 1½ feet; and, in depth, from 1 to 1½ feet. The top-layer of stones is seldom deeper than half a foot below the ground." The graves are always close together, but there is no apparent order in their position or direction. He counted from twenty to a hundred graves in different burying-grounds, which are always situated on some elevation, slight as it may be. The bluff-formation of that region facilitated the selection of proper sites. In graves which had not been disturbed he found the skeletons stretched out at their natural length and lying on the back. The artefacts accompanying the human remains were pointed flints, stone tomahawks, bone implements, marine shells (Pyrula, Marginella), fluviatile shells, and pottery, which, he thinks, "shows more expertness in that art than the present Indians possess." No metallic object was met with by Dr. Wislizenus.

He obtained but four well-preserved skulls, which he presented to the late Dr. Samuel George Morton, of Philadelphia, for his craniological collection. "All of them," he says, "bear the unmistakable signs of the American race, to wit: the broad massive lower jaw, high cheek-bones, salient nose, full superciliary ridge, low forehead, prominent vertex, and flattened occiput."

Dr. Morton, it is well known, divides the American race into two families, according to cranial formation, namely, the *Toltecan*, comprising the formerly half-civilized peoples of America, such as the Mexicans, Central Americans, Peruvians, Muyscas of Bogotá, and others, and the much more numerous *American*, including all barbarous tribes of the new world, excepting the inhabitants of the polar regions, to whom he ascribes a Mongo-

[1] Wislizenus: Indian Stone Graves in Illinois, in: Transactions of the Academy of Science of St. Louis, Vol. 1 (1857), p. 66, etc.—The exploration had taken place in 1843.

lian origin. The mound-builders' skulls which he had occasion to examine are referred by him to the Toltecan family.

Following this classification, Dr. Wislizenus discovered in two of the skulls exhumed by him the characteristics which Dr. Morton attributes to the American family, while the others exhibit what he regards as the Toltecan conformation.[1] These four skulls were found in graves of the same construction, and hence Dr. Wislizenus infers "that persons of both families of the American race have lived, and were buried here, together." He then expresses his belief in the former occupancy of Florida and the Mississippi valley by Toltecs, either before or after their dispersion from Mexico, and, having made some observations on the causes which favored the long preservation of the skeletons, he continues: "Some are of the opinion that modern Indians, as, for instance, the Kaskaskias, are the authors of these graves; but no modern Indians, within my knowledge, bury their dead bodies in this manner; and even the oldest inhabitants of that part of Illinois, who have lived there both with the Indian and the buffalo, do not recollect any such custom among these Indians in burying their dead. It seems, therefore, more rational to suppose that these graves were built and used by an Indian race which disappeared before the intrusion of the white man."

It is quite natural that Dr. Wislizenus should have arrived at such a conclusion, no recent case of a stone-grave burial being known to him; and the circumstance that he had discovered no objects of the white man's handicraft in the graves examined by him, went far to strengthen him in his convictions. Yet he states, at the beginning of his article, that many of the graves "had already, out of mere curiosity, been opened, and their valuable contents been carried off or destroyed, without throwing any light upon their mysterious origin." This fully agrees with my own experience. I have seen quite a number of stone graves, but the majority of them, if I remember correctly, had been opened and deprived of their contents, no one knowing what they were. The discovery of an iron tomahawk, of glass beads, or of other objects not manufactured by Indians, would prove that the practice of interring in stone graves had not become

[1] Though Dr. Morton's great merits are generally acknowledged, his conclusions regarding American cranial formation no longer find strict adherence among later investigators.

obsolete after the contact with the whites. Yet, supposing such articles had been exhumed by ignorant relic-hunters, their significance would not have been appreciated by them, and the very fact of their existence would soon have been forgotten.

I have seen many stone graves in Illinois and Missouri, and have opened a few of them. A short account of my rather limited experience in this kind of exploration was communicated to Colonel Charles C. Jones, who published it in his well-known work on the antiquities of the Southern Indians.[1] I therefore will not repeat in this place what is already in print; but I will draw special attention to a fact, which, though isolated, is of some importance in its bearing upon the question of the continuance of stone-grave burial in recent times.

In 1861, while engaged in the investigations referred to, I visited the farm of Dr. Hammond Shoemaker, situated near Columbia, in Monroe county, Illinois. After some conversation, the Doctor invited me to follow him to one of his maize-fields, and there he showed me an empty stone grave, until lately the last resting-place of a Kickapoo Indian, who, the Doctor informed me, had been murdered many years ago, by one of his own tribe. The incident and the victim's interment by his people were then (1861) still in the recollection of old farmers of the county. As for the grave, I can assert that it differed in no way from others seen by me in the neighborhood. Several years before my visit, the Doctor had opened it and taken out the well-preserved skeleton, being in need of a skull for instructing a young man then studying the medical art under his guidance. Dr. Shoemaker was afterward induced to remove the skull, his wife not liking the aspect of that grim object, and, in order to put it altogether out of sight, he buried it in a piece of ground near his farmhouse. I was very desirous of obtaining the skull, and the Doctor kindly expressed his willingness to part with it, provided it could be found. He took a spade and we went in search of the skull. But unfortunately the area was covered with a dense growth of grass, and as the Doctor could not identify the spot where he had interred the skull, our efforts to recover it proved fruitless.

At that time Dr. Shoemaker was a white-haired, hale old gen-

[1] Jones (Charles C.): Antiquities of the Southern Indians, particularly of the Georgia Tribes. New York, 1873, p. 218, etc.

tleman, and in order to learn whether he still dwelled among the living, I addressed, a short time ago, a note of inquiry to the Hon. William R. Morrison, who represents in Congress the district to which Monroe county belongs. In his reply of June 24, 1882, he states as follows: "He still resides on his farm where you saw him, and has attained to the advanced age of eighty-two years. Strange as it may seem, he still has his little old wagon or gig with two wheels, in which he drives about, practising medicine in his neighborhood."

In the early part of this century the Kickapoos inhabited the country bordering on the central waters of the Illinois, and the head waters of the Kaskaskia and Embarras rivers in Illinois; but they roamed over the whole territory now forming that State, and far beyond it. The last of these audacious and enterprising Indians were removed in 1833 from Illinois to a reservation north of Fort Leavenworth, and they are still located in that neighborhood. A large number of Kickapoos had gone to Mexico, but many of them have returned to the United States.

I have not met with any account in which stone-grave burial proper is mentioned as being practised by modern Indians; yet something similar was observed by John D. Hunter, who lived many years among the Kickapoos, Kansas, Osages, and other Indians of the West. He says: "This ceremony [the burial] is performed differently, not only by different tribes, but by the individuals of the same tribe. The body is sometimes placed on the surface of the ground, between flat stones set edge upwards, and then covered over, first by similar stones, and then with earth brought a short distance; occasionally this stone casing is only applied to the head, and then again, it is altogether omitted. Others excavate the earth to the depth of two or three feet, and deposit their dead below its surface."[1]

It appears to me most probable that the stone graves owe their origin to the race inhabiting within historical times, or even earlier, the districts where they are found. The method of burial, very simple itself, was suggested by the facility of obtaining flagstones suitable for the construction of these primitive coffins, which protected the dead most effectually from the attacks of wild beasts. If, finally, due consideration is given to the circum-

[1] Hunter: Manners and Customs of several Indian Tribes located west of the Mississippi. Philadelphia, 1823, p. 363.

stance that the articles found in the graves in question evince no higher skill than that attained by the more advanced of the historically known tribes of North American Indians, there hardly remains any reasonable ground for not ascribing to such tribes the humble mortuary receptacles treated in this hasty sketch.

——:o:——

ORGANIC PHYSICS.

BY CHARLES MORRIS.

(Continued from page 563, Vol. XVI.)

2. The Organic Function of Oxygen.

The subject here proposed is one to which considerable attention has been paid by inductive science, with the result of conclusively demonstrating that organic activity is strictly dependent upon the presence of oxygen, and that every animal, and each organ of every animal, displays an activity in close accordance with its supply of oxygen. This is about all that has been deduced from the facts observed, but is certainly not all that they indicate. Much wider deductions may be made; some, perhaps, only conjectural, yet others apparently unavoidable, and by their aid a fuller conception of the motor power of the animal kingdom may be gained. Such deductions must also include the vegetable kingdom, since it is now known that plants breathe oxygen as persistently as animals, and that they continue active only during their period of active oxygenation.

But to persistent vital activity nutrition is as essential as oxygenation. The one is the key that winds up the clock of life; the other is the spring that sets its wheels in motion, and frees its restrained energies. Oxygen eats into and breaks down the complex molecules of protoplasm. Nutrition rebuilds these molecules. Thus life forever swings, between limits of chemical analysis and synthesis. In the downward swing it bursts into full activity, and beats against the barriers of the outer world. In the upward swing it relapses into inactivity, and all its energies are employed in the chemical labor of forming new molecules of protoplasm.

These processes can hardly be simultaneous. The reduction of protoplasm by oxidation, and its reproduction in the opposite process cannot take place at once in the same cell.

Probably in every limited portion of tissue oxidation and repro-

duction of protoplasm take place successively. They may occur simultaneously in different regions of the same body, yet there is reason to believe that now the one, now the other, is the ruling agency in the body, as a whole, each having its period of special activity.

This conception has been vaguely approached by some physiologists, but does not seem to have been definitely laid down as a fixed principle of organic action. It is very evident that during the waking or active period oxygen is far more vigorously at work than during the sleeping or passive period. It eats its way into the tissues; it chemically reduces the complex molecules of their cells; it sets at liberty their locked-up energies, and it leaves these energies to be employed in the various modes of organic motion. The mind, the nerves and the muscles are now particularly active. The involuntary functions are also specially active. The heart and the lungs act vigorously, sending the requisite oxygen to every cell in the organism. The preparation of nutriment is also energetic. Food is swallowed and digested. It is absorbed into the blood current, and there undergoes certain chemical modifications. It exudes from the vessels as a nutritive plasma, and is laid up for subsequent use in immediate contiguity to the cells of the tissues.

During this period it is highly improbable that there is any active nutrition. Nutrition needs free energy, and locks up this energy in the molecules produced. But the free energy of the body is now otherwise engaged, and there can be little or none left for the needs of organic synthesis. Moreover, much of the free energy is used up in the selection and preparation of nutrient molecules, and their conveyance to the localities where they are likely to be needed. Thus one phase of the nutrient process is active, but not the final one. There is little or no assimilation of nutriment. The waking period is, therefore the one in which oxidation is in excess; in which the stored-up energies of the body are being set free, and used as animal activity, and in which the body is, as it were, dropping down hill, falling back chemically towards the mineral world.

This phase of life-action limits itself. The affinity for oxygen is largely satisfied, and loses vigor. The cells exposed to oxidation have had many of their complex molecules reduced, and have grown less susceptible to this form of chemism. Their affinity

for nutriment has correspondingly increased, while new nutrient molecules have been stored up in their vicinity. The tide of life turns. From running down it begins to run up. The process of assimilation gains the supremacy, and oxidation of the tissues in great part ceases. During this period there is a marked change in the conditions of life. Assimilation consumes energy. The chemical synthesis cannot go on unless energy be supplied. That which was yielded during the period of oxidation no longer remains in the body. It has been used up in various methods. Temperature energy remains, but that must be kept up, and cannot be reduced in aid of other purposes. It is evident, then, that while assimilation is specially active animal activity must decline or cease. Not only is there no store of energy for mental and muscular action, but there is none for chemical action. Energy must be provided for this purpose, and much of the oxygen which now enters the body is necessarily engaged in this new duty. Oxidation continues, but it is oxidation of the hydrocarbons of the blood or of other low-atomed molecules, to supply the energy required for the rebuilding of the tissues. The sleeping succeeds the waking state, and animal is replaced by vegetable activity.

It will be perceived, by the terms of this hypothesis, that there is required no actual cessation of the two life-processes. Each, in fact, has two separate phases. During the waking period oxygen is busy in the tissues, while nutriment is being actively absorbed, prepared and stored up for future use. During the sleeping period nutrition is busy in the tissues, while oxygen is partly engaged in reducing the innutritious ingredients of the blood and the tissues, and yielding energy for temperature and assimilation, and is partly stored up for future use. Thus each process aids the other, and each succeeds the other in its work upon the tissues. Now oxygen gains the mastery, life thrills in every nerve and muscle, the chemical molecules drop to a lower level of intricacy and the body springs into its active, waking state. Now nutrient affinity gains the mastery, vital activity ceases, the body is being lifted up hill preparatory to another fall, and the passive, sleeping state supervenes.

In plant life there is only one process, instead of two, as in animals. Plants always sleep. Oxidation is active, but it is similar in character to the oxidation that takes place in animals

during sleep. It is oxidation of the combustible materials of the sap current, and yields energy to assist in chemical synthesis. Thus plants display only one of the life processes. Their whole life is passed in the sleeping, assimilative state. They fail to attain the waking, active state.

This distinction is, indeed, not an absolute one. To a limited extent oxidation of the protoplasmic tissues takes place in plants, and to that extent motive energy is possible. In those organs of plants which are specially rich in protoplasm, the leaves and flowers, motor activity is frequently displayed; and in the meat-eating plants, in which chemical synthesis is less exhaustive of energy, there occur at times rapid and well-defined motions, with marked indications of nervous and muscular functions. As a rule, however, it may be said that the sleeping state is normal to plants, both the sleeping and waking states to animals.

Very probably in some of the simpler animals these variations in function take place with much greater frequency than in higher animals. They are periodical, but the periods rapidly succeed each other, so that there is little or no visible indication of a period of inactivity. A like rapid variation also appears to take place in certain tissues of the higher animals, as in the heart. This will be further considered in a later portion of this article.

It appears, from the foregoing considerations, that if we trace the processes of life to their basic condition, we are brought to the chemical activities of protoplasm. Whatever else protoplasm may contain, it certainly contains highly complex, albuminoid molecules, which are its active principles. And the activity of these molecules appears to be strictly chemical in character, and to consist of the following double process. They have an affinity for oxygen. which removes some of their elements, reduces their complexity of composition, and yields free energy. In this reduced state their affinity for oxygen weakens, they acquire an affinity for nutrient molecules, combine with the latter, lock up energy in doing so, and regain their molecular complexity. And life consists in the periodical succession of these two processes.

In all the higher phases of life there are mechanical appliances for the utilization of the energy set free in the first of these processes; but the basis of all life, its fundamental condition, is this chemical activity of albuminoid molecules. To comprehend life, then, we must first comprehend protoplasm; and some fuller consideration of the characteristics above given is desirable.

The life processes are not due to the single fact that oxidation of protoplasm yields unemployed energy. There is needed the secondary fact that protoplasm is so constituted as to make special use of this energy, by conveiting it into mass motion. Did it take only the general form of heat vibration, none of the phenomena of life could arise. We may reasonably ask, then, how does this conversion of free energy into mass motion take place, and what are its special conditions?

Fortunately we are not confined to the organic world for instances of this conversion. Similar phenomena occur in the inorganic world, and possibly the principle of action is in both cases the same. Parellels may readily be drawn between inorganic and organic motor activities, and a consideration of certain results of inorganic chemism may throw light on the phenomena of protoplasmic action.

In considering the motor energies of protoplasm they appear partly indefinite and partly definite; the former consisting of such motions as the streaming of protoplasm in plant cells, and the vague changes of form in the Rhizopods; the latter of the higher animal "modes of motion." The former is continuous, indefinite, general and seemingly purposeless; the latter is temporary, definite, local and with an evident purpose. Yet a close consideration of organic motions shows a connected series of steps between the two phases indicated, and evidences of similarity in their instigating causes, which go to show that they are alike in origin and character.

What is the source of the energy displayed in these motions? There is only one physical source apparent; namely, chemical change. In many instances chemical change evidently attends the motions of protoplasm. This chemical change is an oxidation, and no such movement ever takes place unless oxygen be present. Hence there is warrant for the assertion that all motion in protoplasm results from the action of motive force set free by oxidation, and that for such motion to long continue there must be periods of rest from physical action, during which nutrient molecules can be assimilated, and a condition of ready susceptibility to oxidation reproduced.

But there is an influencing cause of these motions, of essential importance. This is the contact of external substance with the surface of the protoplasmic mass. In nearly every case of animal

motion contact (or its mental resultant) is evidently necessary. Solid substance, or vibratory energy, touches the surface of the cell, or the extremity of conducting lines leading to the protoplasmic cell. An immediate, definite motion occurs in response. We call this sensitiveness, but a mere word explains nothing. The contact of external matter does not provide the motor force displayed, but it in some way sets it free. The force is yielded by some change which takes place in the cell, but this change is instigated by some outward pressure or irritation. And the motion which results is related in position and direction to the source of irritation. If this affect the whole cell the motion will be general and indefinite. If it affect a limited region of the cell, the motion will be local and definite.

In ascribing organic motions to chemical change we are not giving unknown powers to chemism. Inorganic chemical science yields numerous illustrative instances. Mass motion is a common result of chemical action. When a substance changes its character by variation in its chemical condition, a rearrangement of its molecules frequently takes place, causing visible motions, and an eventual change of form in the mass. So the movements of cell protoplasm may arise from molecular rearrangement, caused by chemical change; and the so-called contraction of muscular fibers is really but a change of form possibly due to the same cause.

In like manner the influence of external irritation over organic motion is far from being peculiar. It has many parallels in the inorganic world, of which a few may be here mentioned. Inorganic substances which combine but slowly, or not at all, when mixed and undisturbed, often combine rapidly and even explosively when exposed to external irritation. The cause of this sudden manifestation of chemical affinity is probably a vibration, which flings the molecules together, and thus aids their affinities. In the case of gunpowder, vigorous heat vibration causes instant and explosive combination of molecules. In other mixtures the vibration produced by a blow yield a like result. In like manner a mixture of hydrogen and chlorine gases, which remain uncombined in the dark, combines explosively if exposed to the vibratory influence of sunlight. In all these cases mass motions result, which are definite in direction if the substances be properly confined. A yet more significant instance of sensitiveness to vibra-

tory influence is that of photographic compounds. These can be made so exquisitely sensitive that the faintest touch of the rays of light produces instantaneous chemical change. The responses of protoplasm to touch are even less delicate than those of some of these inorganic substances.

We have considerable warrant for ascribing protoplasmic action to a like result of contact influence. It never takes place except oxygen be present. Probably it is necessary that oxygen should permeate, or be stored up in the protoplasmic mass, the molecules of oxygen and protoplasm being intimately mixed, like those of hydrogen and chlorine in the mixture above referred to. And in both cases the commingled molecules seem to resist the energy of chemical affinity until a vibratory motion, originating without, is sent through the mass, and flings them into closer contiguity.

The mixture of oxygen and protoplasm, however, appears much more sensitive than that of hydrogen and chlorine. In the latter case only the vigorous vibrations of sunlight seem sufficient to induce combination. In the former case every source of vibration yields this effect, as might be expected from the high instability of protoplasm molecules, and the strong affinity of some of their elements for oxygen.

Various sources of vibratory influence exist in nature. First are the radiant vibrations of sound, heat, light and electricity, to all of which protoplasm seems susceptible. Next come several forms of direct contact, as of gaseous, liquid and solid substance, each of which may produce a vibratory thrill. Then there are the vibrations of inflowing or outflowing temperature. Perhaps still other sources of vibration exist, and to all alike protoplasm seems susceptible. Every vibration, even the slightest, from whatever source, which enters into and acts upon protoplasm, apparently induces combination with oxygen (if this element be present), with a consequent freeing of motor energy, and production of some physical change.

Yet, as it would prove destructive to all high animal life should the protoplasm of the cells be exposed to every vibratory thrill of outer nature, and forced to respond thereto, the body generally is covered with a protective coating, through which only the more vigorous vibrations produced by contact pressure and heat energy can pass, and is provided with nerve terminations specially adapted to receive impressions of such character. There are only two

channels through which the more specialized radiant vibrations can reach naked protoplasm; that of the eyes, which suffer only radiations of very high pitch to enter; and that of the ears, which admit only low pitch vibrations. There are two other organs, the nose and the tongue, through whose agency the finer contacts of gaseous and liquid matter reach the naked cell protoplasm. Hence the bodies of the higher animals are susceptible to every mode of contact of external moving energy, but of each in a limited region. It is not that all protoplasm is not equally susceptible to contact of every kind, but that the body protoplasm is shielded at every point from more than a limited range of contacts.

Such is not the case with the protoplasm of the lowest animals. It is exposed to every form of contact, and moves in response thereto. There are no arrangements to limit special contacts to special regions of the mass. The streaming of protoplasm in the plant cells very probably results from the action of light within these cells. We know that it becomes more energetic as the light grows stronger, and there is no evidence that it exists except where transparent tissues are exposed to light vibration. The movements of the Rhizopods are probably due to the same cause. They are apparently without external causation, yet if we consider them closely certain significant indications emerge. These creatures are surrounded by water, and their less definite motions may result from contact pressure of slight water currents. Possibly also light and heat rays may have some influence. In the creeping of the Rhizopods a more definite motion appears. Yet here there is solid contact, and the chemical change induced by this may be the acting cause of the declared production of pseudopodia in that direction, and the creeping translation of the whole body in consequence. Finally comes the most localized of all rhizopodal touch, that of food particles upon the pseudopodia. Immediately a limited and localized motion, specially related to the touching particles, results, and the affected protoplasm closes around and engulfs the touching substance. In the Rhizopod, then, we seem to have a progression from the most vague and general to the most localized and special motions, as touch varies from a faint and general to a vigorous and local influence.

In the Ciliata motion grows much more definite and localized.

Sensitiveness seems confined to special protrusions of the protoplasmic mass, while the remaining surface has lost its irritability. Possibly it has become sheathed in insensitive substance. Cilia are perhaps composed of naked protoplasm, and adapted to perform at once nervous and muscular duties. They may represent in the Protozoa the separate nerves and muscles of the Metazoa; and may also represent, in ciliated epithelial cells, the individual life function of all cells. Everywhere that cells are exposed to external contact they display receptive adaptations; but fail to do so when shielded from contact. The cilia must constantly feel the fine currents which can scarcely ever be absent from liquids. Thrills of vibration may thence be sent down into the protoplasmic mass, and oxidation induced. The energy arising may be reflected back into the cilia, as the most motile portions of the mass. As for their specially directed motions it is quite possible that they may be specially related to the mass, and free to move only in certain directions.

If the motor and sensory functions of single-celled animals are thus confined to minute filaments, the similar functions in the many-celled animals are likewise confined to cellular filaments or fibers, arranged to conduct vibratory energy in certain directions, and to yield motion to certain limbs and organs. The bodies of the higher animals are permeated by lines of conductive material, insulated from the surrounding tissue, and with their surface extremities consisting of naked protoplasm. These conducting lines lead to peculiarly arranged masses of fibers, into which are discharged the vibratory influences which they carry inward. Motor changes take place in these muscular fibers in response, and these changes are always accompanied by oxidation. Quite possibly the motor impulse which the nerve has received from external contact or pressure, is carried inward and delivered to the muscle as a vibratory energy, which induces chemical combination between the commingled oxygen and protoplasm molecules.

All the motor functions of the highest animals are unquestionably results of the physical character of protoplasm, and of its special arrangements. The principles of motor activity which we find in the Rhizopod exist in the man, and no others. Protoplasm, wherever found, is subject to rapid oxidation when external motor influence sends a vibratory thrill through it. This

oxidation yields an energy which manifests itself as mass motion. In the Rhizopod the whole cell is at once nerve and muscle. In the Ciliata these functions are confined to a differentiated portion of the cell. In the Hydra cells appear with nervous functions exteriorly and muscular interiorly. In the higher animals these functions are distributed to separate cells. But there is no evidence that the mode of motion in protoplasm anywhere differs. In all cases alike external impact causes internal vibration, rapid oxidation and quick change of form. The results of these changes depend on special conditions, combinations and attachments of cell masses. There is perhaps nothing peculiar in the muscle cell except its elongated shape. Variation from this shape towards a spherical one must considerably reduce the length of the mass, and produce the effect known as muscular contraction.

The true inorganic parallel to nerve conduction may not be the telegraph wire, as ordinarily assumed. It may have a closer analogy to a train of gunpowder, arranged in successive small masses, and so disposed that the explosion of each shall set fire to the next in the line. If we imagine at the end of the train a larger mass of confined gunpowder, its explosion would symbolize the action of the muscle. Contact with the nerve extremity yields a vibratory impulse, which is confined to the narrow nerve channel, and so conducted inwards. In its course it acts on other minute masses of protoplasm, inducing oxidation and a yielding of fresh energy. Such would seem to be the case from the observed invigoration of the nerve current in its flow. When the vibratory energy is discharged into the muscle it causes oxidation in a considerable mass of protoplasm. And animal motion is produced by the change of shape of the muscle fibers, just as inorganic motion is produced by the change of shape in a released spiral spring.

We define the active organs of the body as nerves and muscles simply because their duties are different, not from any fundamental difference of character. The time may come when the muscles will be looked upon as merely a special aggregation of nerve endings. It was formerly believed that the nerves terminated exteriorly to the muscle fibers, and affected them by some process of induction. But this belief is now abandoned by most anatomists, and it is held that the nerves penetrate the sarcolemma of the muscle fibers, while the nerve sheath becomes con-

tinuous with the muscle sheath. Thus the naked axis cylinder of the nerve comes into direct contact with the muscle substance, and divides until every muscle fiber has its distinct nerve. The nerve extremities spread out on the surface of the fiber into a peculiar plate-like mass. But Professor Gerlach asserts that this is not the true extremity of the nerve, but that it sends minute fibrils onward, which penetrate the muscle fiber, so that there is a most intimate union of nerve and muscle. In the unstriped muscles the nerves form delicate plexuses, and subdivide until a highly delicate intra-muscular network is produced. Frankenhauser traced minute fibrils from this network into the substance of the fiber, ending, as he believed, in the nucleolus of the cell. But Arnold asserts that a filament is continued through the cell, and rejoins the network without. Thus the nuclear fibril seems to be the nodal point of a fine intra-muscular network of nerves.

What should we deduce from these facts? The sarcolemma of the muscle fibers—by whose aid their separate motions are combined and communicated to the limbs or otherwise distributed—is but a continuation of the elastic sheath of the nerves. The nerves divide into minute fibrils in the muscles, and each muscle fiber appears to be but a mass of contractile matter aggregated around a delicate nerve extremity. The richly protoplasmic nerve plate may be an arrangement for a final invigoration of the nerve current, before entering the fiber. It is not found on the slow-moving unstriped muscles, and its purpose may be to aid the vigor and rapidity of movement of the voluntary muscles. From this point of view a muscle is simply a special aggregation of nerve extremities, each of which is surrounded by matter susceptible of rapid oxidation, while their sheaths are so combined and arranged as to be capable of exerting a powerful strain on the limbs or other organs. We may with some reason conclude, therefore, that the method of action in all protoplasm is but one; while the results are as many as there are diverse arrangements of cells.

There is a third constituent of the sensory and motor organism which it is important to here consider—the nerve cell or mass of cells; the ganglion. Under the hypothesis here advanced it might, at first thought, be looked upon as an aid in the process of nerve conduction; as a mass of protoplasm intended

by its oxidation to invigorate the nerve currents. Yet in all probability its purpose is the exact opposite of this; it acts to resist instead of to invigorate the current. The physiology of the nerve system yields evidences of this. One function of the brain cells is, perhaps, to resist the currents over the nerves, and prevent all sensory currents from producing reflex motions. In another portion of the nervous system—the sympathetic—ganglia are interposed in great numbers. There is reason to believe that they act to hinder the outflow of nerve currents. A slight action upon a sympathetic nerve fiber causes motion only in adjacent muscles. A more powerful action causes a wider series of motions, it being perhaps more capable of overcoming the resistance of the ganglia. But only a very powerful impulse is capable of forcing its way through the whole chain of ganglia and reaching the brain. Thus the action of the sympathetic nerves is usually limited to the production of reflex motions, and only affects the brain when the impulse is so energetic as to indicate danger to the economy. When thus called upon the mind is able to directly respond, through the cerebro-spinal fibers, of probably motor function, which accompany the sympathetic.

The anatomy of the nerve cell yields confirmation of this idea. It presents, indeed, a singular analogy to the expedient adopted in telegraphy for the same purpose. It is a "resistance coil" interposed in the nerve circuit. For the recent delicate microscopic investigation of the nerve cell has demonstrated that it is really a congeries of excessively fine fibrils. These penetrate every portion of the cell and its nucleus, and are continued outward by delicate rootlets, or by fibers. The rootlets probably form a network termination to the sensory nerves, and the fibers are the origin of the motor nerves.

As the fine wires in the resistance coil of the electric current check the flow, and permit the operator to control the quantity of electricity passing, or to completely prevent its passage, so may the cell fibrils interposed in the line of the conducting nerve, perform a like duty. Possibly, to a certain extent, the result is the same. The checked current of energy becomes converted into heat. But in one of the ganglia, the brain, it becomes consciousness, or mental energy, a process with which we are not here concerned. In regard to the apparent difference of gangliar termination in sensory and motor nerves, the network of

the former may aid in checking the current, the direct fiber of the latter may assist its subsequent flow.

This hypothesis greatly simplifies the conditions of the motor organism of animals. It consists fundamentally of fibers which permeate the body, and convey motor energy from without inward. At their extremities, and at intervals on their course, these fibers are reduced to minute fibrils, which check the flow of the current, and cause its lateral distribution as heat or vibratory energy. Cellular masses of protoplasm surround these fibrils, constituting the nerve and the muscle cells. The checked energy outflows into this protoplasm, and instigates chemical change there. In one relation of these cells the energy set free by the chemical action is locked up in the mental organism,—how we know not. In another relation it yields muscular contraction, and animal motion. In still other relations it may yield other effects, as above indicated in the sympathetic ganglia. But the fundamental principle is the same throughout. The flow of force is checked, wholly or partly tapped off from the fiber, and employed to instigate chemical action, from which important effects arise. Similarly in an electric circuit fine wires interposed check the current, and part of it outflows as heat which may be used to produce various effects, as the fine wires are surrounded by material differently acted on by heat, and differently arranged. The analogy is a singularly exact one.

If, as is undeniable, all animal activity is a utilization of the normal motions and changes of form in cell protoplasm, and if all these motions arise from oxidation induced by superficial contact with foreign matter, then all active life must depend upon contact influence, and any animal so situated as to feel at no part of its surface any force of pressure from foreign matter could not display the attributes of life. All life is a response to the finger touches of the world without, which set free the dormant energies within, and call them into responsive action. This may seem only partially true, since in the higher animals the mind instigates the greater part of the voluntary motions. Yet the mind has been built up under influences received from without. Whatever its innate character, its energies are resultants of former physical contact. Thus all our motions arise as results of immediate or of former contacts with the sensory nerve extremities. And it is doubtful if even the mind would arouse of itself

from sleep, and if all wakening is not due to external influence acting on the body, and through it affecting the mind.

The most simplified mode of activity in the higher animals is that of the ciliated epithelial cells, which seem to respond to the touch of mucus or other liquid substance. Their utility in the animal economy is, except in a few instances, very evident. But the principal mode of animal activity is that due to excitation of nerve extremities, and the consequent effect upon the muscles. What is known as voluntary motion is obviously due to contact of foreign matter with the external surface, its effects being produced through the intermediate agency of the mind. It has not been fully perceived, however, that all involuntary motion is due to a like cause. This is, indeed, acknowledged to be the case in the operations of digestion. The contact of food with the surface of the digestive cavities is the influencing cause of all that takes place. There are two distinct results of this contact. One is the peristaltic motion of the œsophagus, stomach and intestines, by which the food is kept in motion, and is gradually passed downward. The other is the action on the glands that aid digestion. This is also largely muscular, being principally an action on the walls of the blood vessels, which permits a free flow of blood to the gland, and thus renders secretion more active. The quantity of action in these two directions seems closely related to the vigor of food pressure, and all action ceases when the cavity is empty of food, so that this principle of action keeps an exact harmony between the needs and the supply of motive energy in digestion.

A similar result of contact influence has been traced more interiorly, as in the action of the kidney ducts. Here every drop of the secreted liquid which exudes from the kidney causes peristaltic motions in the walls of the duct, which act to produce a forward movement of the liquid.

From these considerations it becomes probable that another very important function is due to the same cause, although the idea of contact influence has not yet been applied to it. The pressure of the moving blood current upon the wall of the tubes through which it flows must act upon the nerves of those walls, so far as they are provided with sensory nerves. If so, the muscular motions of the heart and the arteries may arise from the irritation of nerve extremities by blood pressure. As the pressure of the current increases, the muscular contraction must grow more vigorous, so that a close harmony between cause and effect is established.

(To be continued.)

THE MINING REGIONS OF SOUTHERN NEW MEXICO.

BY F. M. ENDLICH.

FEW regions, perhaps, attract so much attention at present as the southern portion of New Mexico. Three factors combine to render this section of country interesting to the inhabitants of more civilized domains. Within the past year large areas have been rendered accessible to travelers and investors by the completion of an overland railroad; the discovery of mineral wealth in regions where heretofore it was barely suspected, has imparted the usual energy to the influx of labor and capital, and, lastly, the sporadic appearance of raiding Apaches and their allies has called special attention to the region containing their battlefields.

Upon leaving the railroad traveling assumes a somewhat primitive aspect. Coaches or "jerkies," which latter fully justify their name, are substituted for palace-cars, and "natural roads" supply the place of carefully-ballasted tracks. As a rule the country is well adapted for travel, but little work being required in constructing good roads. All points of prominence can be reached by stage from the railroad. On one of the routes a representative of the immortal "forty-niners" handles the ribbons with consummate skill. "Jim" is a well-known character; the ease with which he guides his team on its daily trip of sixty-five miles, the accuracy with which he steers the coach through a narrow, rocky cañon after nightfall, and his efforts in behalf of the comfort of his passengers, render the drive with him an agreeable recollection. Along the road small, circular or straight walls, hastily thrown together, may often be seen; they mark the spots where unfortunate travelers fought their last, desperate fight against raiding Indians. Even to-day, although danger is rapidly diminishing, the interior of a stage-coach full of passengers emulates the character of an arsenal. However cumbersome the transportation of murderous weapons may be, it is well not to forget the frontier maxim: "Look out for Indians when you don't expect them."

In days gone by mining was carried on in the copper-bearing localities, and active operations were long ago pursued in the vicinity of Silver City and Georgetown. Argentiferous strata

and veins, decomposed near the surface, afforded ample yield of the precious metal. Mexican labor first separated the silver from its base surroundings until the difficulties of deep mining proved too formidable for the indolence of native inhabitants. "White man's" energy and perseverance readily overcame such obstacles until, to-day, the two old-established silver camps are in a thriving condition. Works have been erected for the extraction of silver on the Rio Mimbres and at Silver City, so that the ores are treated within a few miles of their original occurrence. At Santa Rita the copper mines still lie idle, waiting, perhaps, for the magical wand of capital to rouse them from their long period of inactivity. Enormous dumps in the vicinity of the mines speak of great masses of removed material, while ruins of smelting works testify to the extraction of copper from its ore. Now the surroundings of these mines are desolate, be the cause a want of confidence in their productiveness, or be it but one of the many accidents which caused desirable deposits persistently to be mismanaged and neglected.

Indian troubles, to use a standard expression, have somewhat retarded the development of Southern New Mexico within the last few years. Victorio, with his great topographical knowledge, was a born strategician, and in more than one instance brought about the defeat of his enemies by superb leadership. It seems almost ridiculous to the passive spectator, that a mere handful of soldiers, however brave, should be expected to cope with an outnumbering force of savages who have every advantage on their side, and who are fighting with fanatical ferocity under capable superiors. They are well armed, held in good discipline and never strike unless fully prepared to maintain the field. In the Black Range and in adjacent mountains the bleaching bones of cavalry horses tell a tale of battles heroically begun and disastrously concluded. By losses in fights, through the kindly offices of our Mexican neighbors, and in consequence of disease, the original band of marauding Apaches has been reduced to about fifty men. Implacable to the last breath, these still hold out, reinforced, no doubt, at convenient points, by disaffected Indians of other tribes, who quietly return to their agencies after having gained plunder and satisfied their warlike inclinations. Running southward from the *Ojo Caliente*, the main traveling trail of the Indians passes through a part of the coun-

try which now is gradually developing into a series of mining districts. In the spring and fall, as the grass grows and as it withers, the restless bands follow this trail, murdering whomever they can surprise, fighting when safely concealed behind boulders and rocks, running away when pushed into open country. Increasing settlement and the present distribution of military forces under the command of General McKenzie, will have the effect of speedily quieting any further disturbance. Everything is so arranged that a raid can be speedily intercepted, and it is scarcely probable that the scenes of last year will be reënacted.

Within the past year especial attention has been directed towards the mining developments of the Black Range and several of the subsidiary mountain ranges. The Cuchillo mountains, the San Andrea, San Mateo, Caballo, Organ and other isolated groups, have been prospected with more or less success, and work is being prosecuted at many points. At the very borders of a Sierra system which culminates in the Black Range, the mining region of the Lake valley has made the most marked progress. The extent of its deposits, the richness of certain occurrences and the accessibility of the district have directed general notice towards the young camp.

Topographically the entire region is very simple; great areas of plateau land, reaching an altitude of 4000 to 5500 feet above sea-level, are traversed by narrow, monoclinal ranges which trend approximately north and south. They generally owe their most elevated portions to the existence of erupted material. Broad expanses of rolling plains or mesa-like highlands separate the ranges from each other. Water as a rule, is scarce. Within the mountains small streams and springs are abundant, but the majority of them sink upon reaching the open country. Long, narrow valleys, enclosed by undulating hills or steep bluffs, frequently contain lakes or marshy places where water can be obtained by sinking but a short distance. These *cienegas* afford admirable ground for cattle-raising, being supplied with luxurious grass and plenty of shelter. Oak, cedar, piñon and yellow pine are distributed in conformity with elevation and supply of moisture.

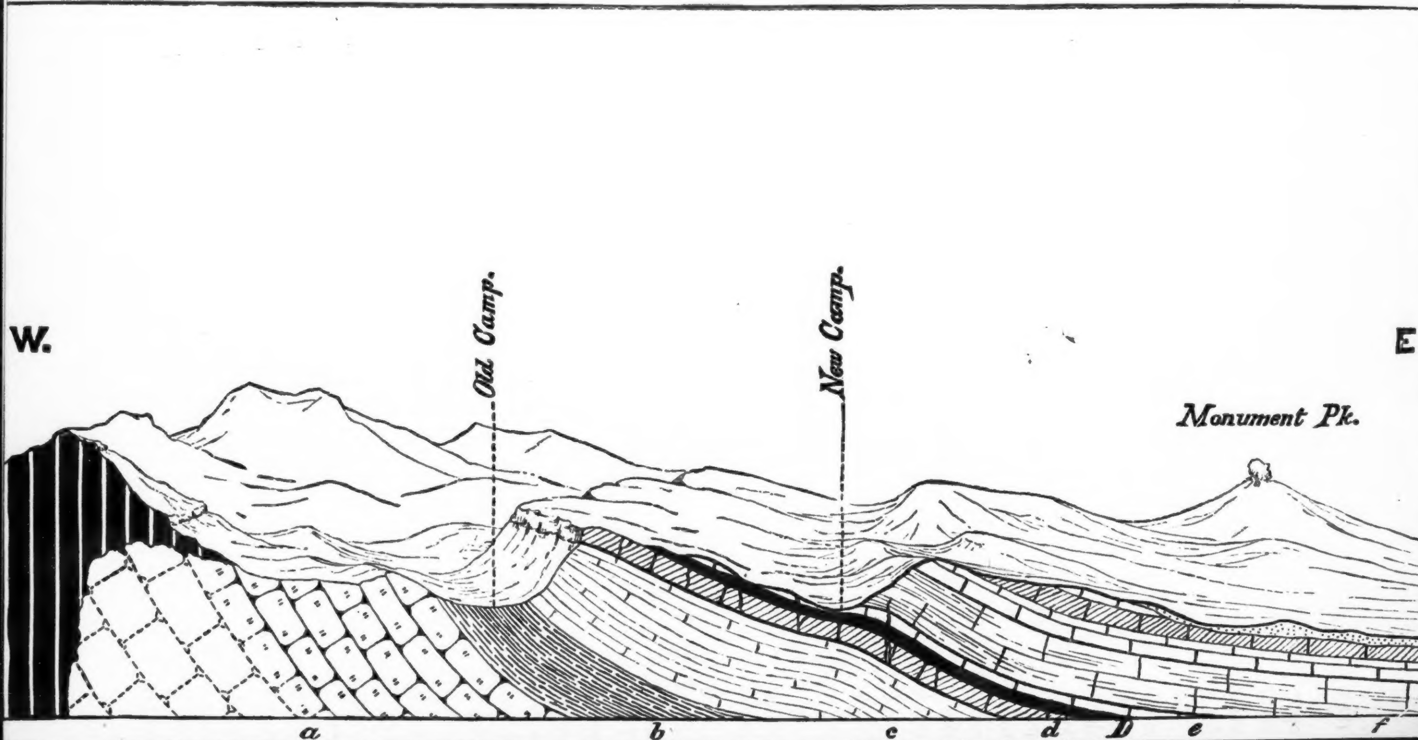
Along those streams which attain sufficient volume to withstand the absorbent qualities of the valley-soil, notably the Mimbres and the Cuchillo Negro, Mexican settlements eke out their

lazy existence. In the hands of an enterprising people all valleys thus supplied with water might be rendered highly productive. A little corn, plenty of red pepper, the national *chili colorado*, a few sheep or goats and pigs comprise the worldly ambition of the swarthy inhabitant. Cutting ditches for irrigating purposes, planting and reaping more grain or corn than is needed for individual wants, require labor, and life seems too short to the Mexican to waste it in so uncongenial a manner. Now and then an American (American by way of distinction) ranch will be met with, and its possessors are found in enjoyment of ample returns for their thrift and industry.

A Mexican town presents a very forlorn appearance. Gray mud composes the buildings, brown mud the streets and black mud the fields or gardens. Lazy, dirty, wretchedly poor, the inhabitants manage to procure from day to day the means of keeping body and soul together. Few of them can be persuaded to work unless it be in connection with horses or cattle. Squalling children and lean, sharp-backed pigs wallow in mud, alike, almost, in appearance as in intellect. Even one of the chief amusements of our own more civilized backwoods, sitting on fence-rails of a Sunday and whittling, is denied these unfortunate creatures. Whenever an attempt at fencing is made, our posts and rails are supplied by a wall of sun-dried brick, on the top of which are planted dense rows of aggressive cactus. Small as the intelligence of the average Mexican farmer may be, it suffices to teach him that cactus are not pleasant to sit upon for Sunday recreation. Only their graveyards are in good condition; they are carefully tended, embellished with numerous white crosses, and protected by massive walls against the interference of coyotes.

Since the discovery of metalliferous veins, coinciding as it did with the advent of a railroad, large numbers of prospectors, miners, mechanics and a fair percentage of professional scoundrels have flocked into the country. Small "American" settlements have sprung up in the mining regions, notably Grafton, Hillsboro and Daly (Lake valley), so that the extraction of ore is gradually assuming the character of a legitimate business enterprise throughout the Black Range and its adjoining districts. Prospectors are daily covering more ground, and ere long the more distant ranges will be drawn within the circle of active

MIAMI UNIVERSITY.



SECTION OF THE SILVER-BEARING DISTRICT OF LAKE VALLEY, NEW MEXICO. SEE TEXT.

operation. Reports, vague as yet, fill remote mountains with untold wealth, but a short time only may elapse before definite knowledge and practical demonstration will separate truth from fiction.

Geologically speaking the structure of Southern New Mexico is not complicated when viewed on a large scale, although a thorough recognition of details would require careful study. Taking the general character of the ranges it may be said that they exhibit a large mass of erupted material which forms their highest peaks. Flanking the latter are sedimentary beds, referable mainly to the Palæozoic groups. These follow essentially a monoclinal arrangement more or less complicated by faults. Sharply defined, the ranges trend north and south, end more or less abruptly, and, though orographically disconnected, belong to one general period of geological disturbance. In elaborating the geognostic details, however, a wide field for observation is encountered. Without attempting to enter minutely upon a subject which would carry us far beyond the limits assigned to this paper, it may be well to sketch, in brief outlines, the distinctive features of the region under discussion.

Keeping in view the presence of eruptives which form the bulk of the mountain ranges, we find the adjacent sedimentary beds traversed or covered by the volcanic material in every direction. Trachyte, resembling that of the San Juan region in Colorado, predominate. Dolerites, in part sanidinitic, are not wanting, but subordinate. Dikes of trachyte set across either dip or strike of sedimentary strata, and intrusive wedges of the same material are held between the latter. From the main points or lines of issue the trachytes have spread in the form of flows, wherever their quantity and the surface of the locality permitted. Arranged in nearly horizontal layers, they now cover unconformable sedimentary beds. Erosion has carried away large portions of erupted material, leaving isolated remnants of flows and again exposing the underlying formations.

Among the sedimentary beds those belonging to the Carboniferous period are most fully represented, although Silurian quartzite and the characteristic "red beds" of Mesozoic age are also found. Wherever contact has been established with the trachytes, the traces are plainly visible in the limestones predominating in the Carboniferous series. The influence of heat has

caused a certain amount of fritting, a characteristic discoloration and the formation of numerous, irregular fissures, cracks and seams. Even where the overlying volcanics have been removed by erosive agents, their former position can often be established by the record they have indelibly stamped upon the strata which were exposed to their altering influence. A large percentage of the total area is covered with heavy deposits of drift, sometimes several hundred feet in thickness, whereby all recognition of underlying beds is rendered impossible.

Considering the relations between sedimentary and volcanic material as exhibited in this region, it is but natural that the existence of extensive veins should be expected. In truth, such veins are found, and by virtue of surrounding rocks they are metalliferous. In the heart of the Black range, at and near Grafton, well-defined veins traverse the limestones as well as the trachytes, bearing definitely characterized gangue and ore. Frequently they lie in contact between the two. Their gangue is mainly quartz in this region. As quartz resists decomposition more successfully than the enclosing walls, the veins can often be traced for long distances. Generally they cut the edges of the limestone strata, *i. e.*, their strike coincides with that of the beds they traverse. Occasional faults and cross veins are produced by the occurrence of dikes, which, in turn, are almost as persistent in course and continuity as the veins themselves. Near Hillsboro' similar veins have been found, and are now profitably working. While these latter carry gold as the paying metal, silver usually predominates, and gold in excess of a few ounces per ton enters only sporadically. At Hillsboro' the auriferous character of deposits has given rise to the formation of gold-placers. Located within accessible distance from water, they have been turned to account and are now yielding their precious metal under the persuasive influence of hydraulic mining.

On the waters of the Pirches, above Hillsboro', and at Lake valley, the ore deposits show a totally different geognostic and mineralogical character, although their associations are essentially the same. While the more northerly mountains hide their metallic treasures in well-defined veins which cut through and across the country rock; while these veins carry a specific gangue with the argentiferous and auriferous minerals distributed therein; in short, while they promise to develop into orthodox,

old-fashioned mines, we here meet with ore bodies of totally different genesis, different relative position and different minerals. Instead of barren gangue and paying ore, we find a deposited accumulation of ore varying in value; instead of argentiferous *veins* we have argentiferous *beds.*

At Lake valley active work has been going on since the spring of 1881. As this district shows more prominent development than others of a similar character, it may be well to enter into some detail concerning genetic and stratigraphical conditions, both of which are of exceptional interest. For the purpose of presenting the subject in a more comprehensible manner, a section may serve which has been taken across the strike of the ore-body.[1]

Beginning at the western end of the section we find a portion of the trachyte (*A*), belonging to the range which has broken through and partly overflowed heavy beds of quartzite (*a*). The latter are probably of Silurian age. They dip steeply away from the mountains until hidden from sight by a series of dark gray shales (*b*). A narrow valley, in which the old camp was located, is eroded into the shales, readily yielding, as they do, to disintegrating and transporting agents. So far as could be determined, the argentiferous shales of Silver City belong to this horizon. Above them light gray and yellow calcareous shales (*c*) form the steep approach to the summit of the first outlying "hog-back" or ridge. The latter is protected by a capping of massive blue, silicious limestones (*d*). This limestone forms the floor, or, using mining parlance, "foot-wall" of the ore-bed (*D*). Conformable in every way to over and underlying beds, this deposit of argentiferous ore must be regarded as an integral member of the series of strata which compose the two parallel ridges or hog-backs. Overlying the ore-bed we find a more or less compact, whitish limestone, the "hanging-wall" (*e*), followed by a succession of fossiliferous, argillaceous limestone (*f* and *g*), which, in turn, are hidden by drift (*h*). About thirty species of fossils were here collected, the identification of which refers the series to the Lower Carboniferous formation.

Both limestones which form the walls of the interstratified ore-bed, are traversed by ore-bearing veins and seams. Usually these

[1] It must be stated that the section is not made on scale, as no accurate contour surveys of the surface have been made thus far.—E.

are of comparatively small dimensions, stand nearly vertical, and show ore of a higher grade than the bulk of the main deposit. It is a noticeable feature that no such veins have been found in the shales (*c*) underlying the foot-wall strata (*d*). Mineralogically the ore of this locality must be considered as an aggregate of manganese and ferric oxides with but a slight admixture of gangue rocks. The silver is distributed throughout the mass of ore in the form of cerargyrite (chloride), embolite (chloro-bromide) and a small percentage of argentite (sulphide). It is well known how the first two of these minerals were struck in large quantities, of great purity, at various points in the ore-bed, furnishing ore worth from five to ten dollars a pound.

Near the crest of the first ridge the ore-bed has been removed by erosion, together with the overlying strata. On its easterly slope mining is essentially reduced to open quarry work, because the hanging-wall (*e*) has been broken away at many places. Following the dip of enclosing strata, the ore sinks out of sight under the second hog-back, directly east of the new camp. Along the strike of the strata, *i. e.*, approximately north and south, the ore-bed either crops out or has been struck in its normal position for a distance of more than 2000 feet, always bearing the same relations to adjoining strata. Towards the east it may extend indefinitely. No disturbing action has turned up the strata in that direction, so that the point could be demonstrated. Defining, then, in a few words this occurrence, we find it to be: a manganese and iron bed, conformably interstratified with carboniferous limestones, impregnated and associated with specific silver minerals.

Beyond the establishment of this ore-body as a well-defined stratum, a highly interesting question is propounded in the existence of the transverse veins and seams above alluded to. Primarily we may take for granted the formation of a manganese and iron bed, synchronously with the deposition of the entire sedimentary series. From evidence obtained in the vicinity of Lake Valley, it appears that the trachyte flowed from the more elevated regions in an easterly direction. Subsequent disturbances and erosion affected the removal of the larger portion of the volcanic material. Monument peak, in close proximity to the mines, is a remnant of a flow from the westward. There seems no room for doubt but that the ridges now containing the ore-bed were at one

time covered by the trachytic flows. It is further found that the hard, unyielding strata of limestone and quartzite are fissured and cracked to a very great extent, while the more pliable shales are not so affected. The argillaceous limestones (*f*) show fissures of only small dimensions. It seems highly probable, therefore, that the combined pressure and heat of the superincumbent trachytes should have been instrumental in causing the extensive system of fissuring now observed more particularly in the limestone walls. Wherever cracks thus formed were in connection with the original ore-bed, they would have been filled from the latter, by some process, probably, which could derive material aid from the presence of heated masses overlying. One hypothesis of this kind might also account for the high average grade of ore found in the transverse veins as compared with the main ore-body.

The treatment of ores from the districts above described has met with no obstacle thus far. By milling process the lower grades can be utilized, while smelting is advisable for the higher. For a long time the Mexicans have smelted a limited quantity of certain classes of ore. They are, no doubt, very skillful in manipulating ores with which they are familiar, but their crude methods and their conservatism, born of constitutional laziness, prevent their harvesting the riches of the country they inhabit. It is surprising, sometimes, to see the results obtained by them in their small *adobe* furnaces. Capable of smelting perhaps 500 pounds of ore a day, the construction closely resembles that of an ordinary silver-lead furnace. By means of cupellation, all blast being supplied by hand-power bellows, they produce silver of 930 fineness. Their entire plant seems almost like a plaything, but it is constructed upon sound principles and handled with enviable skill. Until the arrival of Eastern machinery these miniature smelters afforded the only means of extracting the precious metals from their ores. Now they have had their day, and are rapidly falling into disuse.

RECENT DISCOVERIES OF FOSSIL FISHES IN THE DEVONIAN ROCKS OF CANADA.

BY J. F. WHITEAVES.

DEPOSITS containing remains of fishes remarkably like those of the old red sandstone of Scotland and Russia were discovered by Mr. R. W. Ells, M.A., of the Geological Survey of Canada, in 1879, at Scaumenac bay, on the north shore of the mouth of the Restigouche river, almost immediately opposite Dalhousie. To a certain extent, however, this discovery had been anticipated by Dr. Abraham Gesner, who, in a report on the Geological Survey of New Brunswick, published in 1843, states that in the previous year he found " remains of fish and a small species of tortoise, with fossil foot-prints," in the shales and sandstones of Scaumenac, or as he calls it, of Escuminac bay. Prior to 1879 all the rocks which skirt this bay were regarded as belonging to the Bonaventure division of the Lower Carboniferous, but we now know that at this locality the conglomerates and red sandstones of the Bonaventure series are underlaid, perhaps unconformably, by shales and sandstones of Devonian, and most probably of Upper Devonian age.

On behalf of the Canadian survey, Mr. A. H. Foord has devoted the whole of the summer seasons of 1880 and 1881 and part of the present summer to a systematic exploration of these fish-bearing beds, and has obtained from them an extensive and instructive series of specimens.

The genera and species of fishes collected by Mr. Foord and other members of the survey at Scaumenac bay may be thus briefly indicated.

1. Pterichthys canadensis. By far the most abundant fossil at this locality is a fine species of Pterichthys which has been provisionally described, under the name *P. canadensis*, in the "American Journal of Science" for August, 1880. The specimens collected show nearly all the characters of the helmet, buckler, plastron and pectoral spines in great perfection, but no vestige of the tail has yet been detected, nor of any of the fins other than the pectorals. In the number, contour and disposition of the plates on the upper and under surface of the head and body, and in the shape and mode of articulation of the pectoral spines, the Canadian species agrees precisely with Pander's well known restoration of Pterichthys, but its sculpture is exactly like that of Bothrio-

lepis. The genera Asterolepis and Bothriolepis of Eichwald, it should be premised, were both based upon detached bony plates of fishes from the old red sandstone of Russia, in 1840, and the distinctions between them were founded on peculiarities in their surface ornamentation. In Asterolepis the sculpture of the exterior consists of numerous, minute, isolated, conical tubercles, with radiating striæ around their bases and in the interstices between them, while in Bothriolepis the markings of the same surface consist of shallow pits, perforated by vertical canals and encircled by a more or less complete network of raised ridges. All the species of Pterichthys described and figured by Agassiz in his monograph of the fishes of the old red sandstone have the sculpture of Asterolepis (Eichwald), but the Canadian form which in every other respect is a true Pterichthys, has the pitted ornamentation of Bothriolepis. Pander, however, in his memoir on the placoderms, has maintained that Bothriolepis and Pterichthys are both synonyms of Asterolepis, and the Scaumenac bay specimens certainly show that there is no essential difference between Pterichthys and Bothriolepis. Moreover it is exceedingly likely that the Canadian Pterichthys is specifically as well as generically identical with the *Bothriolepis ornata* of Eichwald, though the latter species has never been described nor figured with sufficient accuracy to be recognized with any degree of certainty.

There are two other points of interest in connection with this species of Pterichthys. In the monograph of the fishes of the old red sandstone already referred to, Agassiz gives an ideal restoration of the genus. In this restoration the front margin of the head is represented as bearing a pair of divergent and slightly curved labial appendages or barbels, which the author in the text claims to have seen in specimens of his *P. latus*, but which he indicates in the diagram by dotted lines, as if in some doubt of their actual existence. These barbels are omitted altogether in Pander's more recent restoration of the same genus, reduced figures of which are reproduced in several of the geological manuals of the day. Yet in one of the specimens collected by Mr. Foord the barbels are plainly visible and do not differ either in shape or position from those indicated in Agassiz's diagram, except that they are a little closer together at their bases or points of attachment. The flattened conical, dermal processes on the upper side of the helmet, one on each side of the orbit, as repre-

sented in Pander's restoration, are also well seen in two of Mr. Foord's specimens, though in these they are directed forwards as well as outwards, whereas in Pander's figures they are depicted as though they were bent backwards.

2. Diplacanthus, sp. undt.—An apparently undescribed species, of which only a few imperfect examples have been collected. It appears to be remarkable chiefly for the comparatively small size of its fin spines in proportion to that of the head and body.

3. Acanthodes mitchelli? Egerton.—Ten or twelve specimens of a diminutive acanthodean which seem to be barely distinguishable from the Scotch species named above. The largest perfect individual is not more than an inch and three-quarters in length, and the scales, when examined under the microscope, are seen to be perfectly smooth.

4. Phaneropleuron curtum.—This remarkable genus was first described by Professor Huxley, in 1871, in the tenth decade of organic remains issued by the Geological Survey of Great Britain. Its principal characters are as follows: scales thin, cycloidal, dorsal fin extremely long, single and confluent with the upper lobe of the tail, pectorals and ventrals acutely lobate, jaws armed with a single series of short conical teeth, vertebral centers not ossified. The only species previously known was the *P. andersoni* of Huxley, from the old red sandstone of Dura Den in Fifeshire, a long narrowly fusiform fish whose length is more than five times its maximum height or depth. At Scaumenac bay, in 1880, Mr. Foord obtained four crushed and distorted but nearly perfect examples of a new species of Phaneropleuron, which has since been described in Vol. x, No. 1 of the *Canadian Naturalist*, as *P. curtum*. It is a shorter and broader fish than *P. andersoni*, its length being not much more than twice its height. The largest specimens collected in 1880 are a little more than six inches in length, but an individual found by Mr. Foord at the same locality in 1881 is fifteen inches long.

Professor Cope has shown that of all the Devonian fishes, Phaneropleuron comes nearest to the living *Ceratodus forsteri*, of Queensland, both in its internal and external characters, but the dentition of Phaneropleuron was only partially known. Last summer Mr. Foord was fortunate enough to obtain specimens, showing that in addition to the simple conical teeth with which the dentary bone is armed, the Canadian species is furnished with triangular palatal

teeth, each furnished with rows of conical denticles. These palatal teeth are precisely like those of Dipterus as figured by Hugh Miller in the "Footprints of the Creator," and the affinities of Phaneropleuron with the living Ceratodus and with the Dipnoi generally are thus rendered still more apparent.

Eusthenopteron Foordi.—In the same paper as that in which the preceding species was described, the above provisional name was suggested for a number of large fragments of a fish, which, when perfect, must have attained to a length of fully three feet. The largest specimen consists of a portion of the posterior end of the fish about a foot in length, which shows the external characters tolerably well, though the caudal, anal and second dorsal fins are imperfect. The bony supports of each of these fins and about five inches of the vertebral column, or rather of its lateral elements, are beautifully preserved in another specimen. The only parts of the head then recognized were fragments of a dentary bone, with teeth, and some isolated cranial plates, one of which is evidently the operculum.

In the sculpture of the cranial plates, in the shape and ornamentation of the scales of the body, and in the fact that the fin rays of the second dorsal and anal are both supported by three osselets articulated to a broadly dilated spinous apophysis, this supposed new genus very closely resembles the Tristichopterus of Sir Philip Egerton. But it is well known that in many Devonian fishes the notochord was persistent, and Sir P. Egerton calls special attention to the fact that Tristichopterus is an exception to this rule, its vertebral centers being completely ossified. Further, the osselets of the lower lobe of the tail of Tristichopterus are described as "springing from eight or nine interspinous bones." In Eusthenopteron, on the other hand, the vertebral centers do not appear to have been ossified at all, and the osselets of the lower lobe of the tail are articulated to the swollen outer extremities of the hæmal spines.

More recently, in 1871, a number of additional specimens of Eusthenopteron have been collected by Mr. Foord, which throw much new light on its structure. Small specimens show that the peculiar central and accessory lobe developed between the upper and lower lobes of the tail, which suggested to Sir P. Egerton the name Tristichopterus, is common to that genus and to Eusthenopteron. The general shape and position of the fins, too, ap-

pear to be sufficiently alike in both genera. The jaws of Eusthenopteron, like those of Tristichopterus, are each armed with an outer row of small teeth, and an inner row of large ones, but the teeth of Tristichopterus are simply conical and circular in transverse section, whereas those of Eusthenopteron are flattened conical with lateral cutting edges. The jaw of Eusthenopteron is remarkably like that of the Asterolepis of Hugh Miller, but not of Eichwald, as figured in the "Footprints.".

Glyptolepis. Compare *G. microlepidotus* Ag.—A single badly preserved example of a species of Glyptolepis which resembles the *G. microlepidotus* of Agassiz in the small size of its scales. These scales, which are for the most part exfoliated, and which in no case show the sculpture characteristic of the genus, average less than two lines in diameter. The fins of the side exposed to view are tolerably well defined, and the outline of one of the slender, elongated and acute, lobate pectorals is somewhat clearly shown. The specimen agrees perfectly with Huxley's restoration of Glyptolepis, in the shape and position of its fins, and in the contour of its tail.

Glyptolepis. Compare *G. leptopterus* Ag.—A second species of Glyptolepis, apparently of the type of *G. leptopterus*, appears to be indicated in Mr. Foord's 1880 collections by two or three large isolated scales. These scales, which are nearly an inch in length, are ornamented with the wavy costæ and semilunar or crescentic area of backwardly directed points peculiar to the genus.

Cheirolepis canadensis.—Four fine and well preserved specimens of a large species of Cheirolepis, nearly related to the *C. cummingiæ* of Agassiz, of which it may prove to be only a local variety. According to Hugh Miller, the large pectorals of *C. cummingiæ* "almost encroach upon the ventrals, and the ventrals upon the anal," but this is by no means the case with the *C. canadensis.* In the latter species, or variety, the ventral fins are situated considerably in advance of the mid-length, and are separated from the pectorals by a short interval. The anal fin is placed much farther forwards than the dorsal, and is separated from the ventrals by a space slightly exceeding in length the height of the body at the commencement of the anal.

The analogies between the fossil fauna of the Upper Devonian rocks at Scaumenac, and that of the old red sandstone of Scotland and Russia are very striking. With the exception of Eus-

thenopteron, all the genera yet found at Scaumenac, are those with which the readers of Hugh Miller will be familiar. Of the seven genera of fishes found so far at Scaumenac, six occur also in Europe, and of the eight species collected by Mr. Foord, probably one-half will yet prove to be mere varietal forms of European species. The *Pterichthys canadensis* is most likely the same as the *Bothriolepis ornata* of Russia and Scotland; the Acanthodes appears to be referable to the *A. mitchelli* of Egerton; one of the species of Glyptolepis may be identical with the *G. microlepidotus* of Agassiz and the *Cheirolepis canadensis* is probably a variety of the *C. cummingiæ.*

The existence of fossil plants, as well as of fish remains, in the shales and sandstones of Scaumenac bay was noticed by Dr. Gesner in 1842, and from these rocks Mr. Foord also obtained a series of specimens of four species of ferns which have recently been described by Principal Dawson. These Devonian deposits at Scaumenac may have been of fresh water or estuarine origin, for no traces of any marine invertebrata have yet been detected in them, and the fossil fishes which they contain are invariably found associated with land plants.

On the south bank of the Restigouche, about half a mile above Campbellton, another series of fish-bearing strata was discovered by Mr. Ells in 1871. These deposits have also been carefully explored by Mr. Foord, and a preliminary description of the species collected by him has been published in Vol. x, No. 2, of the *Canadian Naturalist.* At this locality the remains of fishes occur in brecciated limestones of Lower Devonian age, which latter are much disturbed by trappean outbursts and overflows. The specimens, though sometimes well preserved, are generally fragmentary, and the species recognized so far are as follows:

Coccosteus acadicus.—Cranial shields and detached post-dorsomedian, ventromedian and preventrolateral plates of a species of Coccosteus whose characters appear to be intermediate between those of the *C. cuspidatus* and *C. decipiens* of Agassiz. The dorsomedian plate of *C. acadicus* is precisely like that of *C. cuspidatus*, but the superficial grooves on the cranial shields of the Campbellton specimens correspond perfectly with those represented in Hugh Miller's diagram of the head shield of *C. decipiens.* It is not at all unlikely that *C. decipiens, C. cuspidatus* and *C. acadicus*

may eventually be found to be mere varietal forms of one somewhat variable species. So far all attempts at tracing out the true sutures on the cranial shields of the Campbellton Coccosteus have entirely failed, although one specimen has been ground down in the manner suggested by Professor Huxley.

Cephalaspis campbelltonensis.—Large head-shield of a Cephalaspis, probably belonging to the section Eucephalaspis of E. Ray Lankester, with the orbits well defined and the prominences and depressions of the central region very clearly shown. All the specimens are very much crushed and distorted and nearly all are exfoliated. Portions of the true outer layer of the test have been seen only on the central portion of the outer margin of the left hand side of one large fragment, and on the extremities of the cornua in two or three other specimens. The enamel of the true outer surface appears polished and nearly smooth to the naked eye, but under a lens it is seen to be minutely and densely pitted, the pits being very irregular in their shape, size and method of arrangement. Where the enamel is removed the surface is divided into numerous well-marked polygonal areas.

Including the *C. dawsoni* of Lankester, from Gaspé, all the species of Cephalaspis hitherto described are said to be characterized by a surface ornamented by raised tubercles, usually of very small size, so that the *C. campbelltonensis* may be readily distinguished by its minutely pitted sculpture.

Ctenacanthus latispinosus.—This species is represented in Mr. Foord's collection by a few fin-spines about two inches and a half in length, which are chiefly remarkable for the regularly nodose structure of their radiating ribs.

Homacanthus, sp. undt.—A single imperfect and badly preserved spine of a species of Homacanthus, which, as far as can be ascertained at present, resembles the *H. arcuatus* of Agassiz in almost every respect but that of size, the Campbellton species being much the larger of the two.

The fossil plants as well as fishes found at Campbellton appear to be entirely different to those of Scaumenac bay, and at the former locality entomostraca, *Spirorbis erianus*, fragments of a large Pterygotus, and two new species of Cyclora are associated with the fishes.

ON THE EXTINCT RODENTIA OF NORTH AMERICA.

BY PROFESSOR E. D. COPE.

Miocene Rodentia.

(Continued from page 57.)

Eumys (Leidy) Cope.

With this genus we commence an account of the mice of Miocene times. Representatives of this primary division were not as numerous during this period in North America as they are at the present epoch, and very few of them displayed the prismatic type of molar teeth, as do the Arvicola or meadow mouse, and muskrat, genera of later periods. In Eumys we have the predecessor of our wood-rats and mice, but which unites with some dental characters of these animals, the cranial form of Fiber or the muskrat. The molar teeth are tubercular, with alternating lobes as in Hesperomys (wood-mouse), but there are intermediate cross-crests on the inner side of the lower, and outer side of the upper jaws, so that when worn, the crowns present exactly the pattern of Gymnoptychus. There are no ridges bounding the orbits above, and there is a median or sagittal crest. This is a character of various primitive rodentia, retained in the Arvicoles and muskrats.

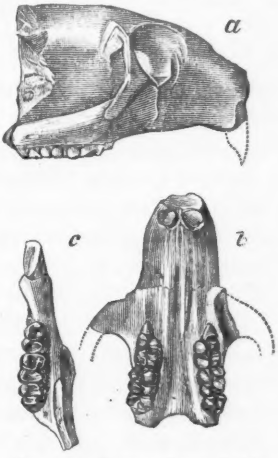


Fig. 14.—*Eumys elegans* Leidy; parts of skull and mandible with little worn molars. Twice natural size. From the White River beds of Colorado. Original. From Vol. IV, U. S. Geological Surv. Terrs.

But one species is known, the *Eumys elegans* Leidy. It is only found in the White River beds of Nebraska and Colorado. It was as large as a Pennsylvania meadow-mouse, and must have been exceedingly abundant. See Figs. 13–14.

Hesperomys Waterhouse.

This existing genus is represented by a species *(H. nematodon*

Cope) in the John Day beds of Oregon, and by a second species in the Loup Fork formation of New Mexico and Nebraska (*H. loxodon* Cope). A beautiful cranium of the former was found by Professor Condon of the University of Oregon, and others have been obtained by Mr. Wortman. It was intermediate in size between the recent wood-rats and mice. The *H. loxodon* was smaller. See Fig. 15.

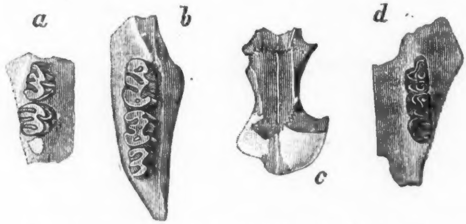


FIG. 15.—*a* maxillary; *b* mandibular teeth of *Paciculus insolitus* Cope, twice natural size. Figs. *c–d*, *Hesperomys nematodon*; *c*, frontal region from above, nat. size; *b*, maxillary teeth, twice nat. size. From the John Day beds of Oregon. Original.

PACICULUS Cope.

This genus is probably one of the Muridæ, and a near ally of the recent Sigmodon and *Neotoma*. It differs from these genera in having three external inflections of the enamel in the superior molars instead of two. It differs from Hesperomys as these two genera do, viz., in having deep enamel inflections instead of tubercles and valleys. It is true that the deepening and narrowing of the valleys of the molars of Hesperomys would result after wear in a pattern like that of Neotoma. The same process in Eumys would produce a pattern much the same as that of Paciculus, but that genus is further characterized by the contraction of the postorbital region and the production of a sagittal crest, which are not found in Paciculus.

Two species of this genus are known to me, *P. insolitus*, a smaller (Fig. 15 *a b*), and *P. lockingtonianus*, a larger one, which is about the size of the wood-rat. Both are from the John Day beds of Oregon. They demonstrate an early origin for the American type of Neotoma, as contemporaries of the first of the Hesperomys. (Fig. 15.)

PLEUROLICUS Cope.

The exclusively American family of the subterranean "gophers," or Saccomyidæ, was well represented in Oregon, and probably in other regions, during the John Day epoch. As yet

they have not been found in the Loup Fork formation, but they occur in the Pliocene Equus beds. Two genera are known, the one above named, and Entoptychus Cope. They are very nearly allied to existing genera. In the former the molars are rooted and have short crowns, and a fold of enamel on one side of the crown is always open. In the latter, the molars are prismatic and rootless, and the lateral enamel fold becomes on wearing an isolated lake.

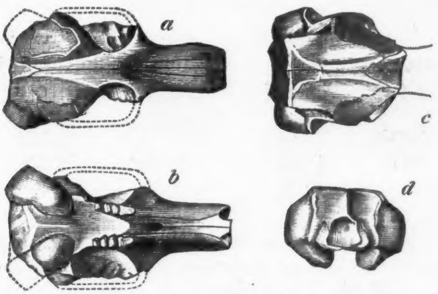


FIG. 16.—*a–b*, *Pleurolicus leptophrys* Cope; skull, *a* above, *b* below; figs. *c d*, *P. diplophysus* Cope, postorbital part of skull, *c* from above; *d* from behind. Nat. size. From the John Day epoch, Oregon. Original. From Vol. IV, Report U.S. Geol. Surv. Terrs.

Pleurolicus is curiously near to the existing Heteromys and Perognathus, the two genera of Saccomyidæ with rooted molars. The former differs in having the molars divided into two columns, each of which is sheathed in enamel, while Perognathus only differs, so far as I am aware, in having the superior incisors grooved. It is also very nearly related to Entoptychus, and two of the species correspond in various respects with two of those of that genus. In view of the fact that most of the specimens of the *P. sulcifrons* are old individuals with well worn molars, the idea occurred to me that the rooted character of the molars might be common to the species of Entoptychus, but that it might not appear until long use had worn away most of the crown, and the protrusion had ceased. Examination of the bases of the long molars of *E. planifrons* did not reveal any roots. It is also opposed to this view that the maxillary bone in the Pleurolici has little depth below the orbital fossa, appropriately to the short-rooted molars, while the depth is considerable in the typical Entoptychi, though there is a complete gradation in this respect. But I have demonstrated satisfactorily that Pleurolicus is a distinct genus by observations on the *P. leptophrys.* Some of my individuals of this species are young, with the crowns of the molars little worn, yet the roots diverge immediately on entering the alveolus, on all the molars. In the species of Pleurolicus the lateral fissure of the

crown descends to its base, and hence persists longer than in the typical Entoptychi.

I am acquainted with two species of this genus. The posterior part of the skull of an individual represents a third species, which I refer provisionally to this genus. See Fig. 16.

ENTOPTYCHUS Cope.

Molars $\frac{4-4}{4-4}$, rootless, and identical in structure. The crowns are prismatic, and in the young stage present a deep inflection of enamel from one side, the external in the superior teeth, the internal in the inferior. After a little attrition, the connection with the external enamel layer disappears, and there remains a median transverse fossette, entirely inclosed by enamel. The tooth then consists of two dentinal columns in one cylinder of enamel, separated by a transverse enamel-bordered tube. Incisors not sulcate.

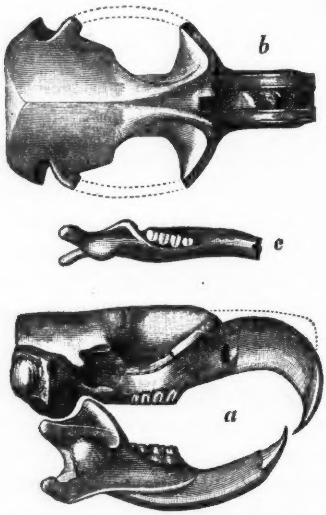


FIG. 17.— *Entoptychus crassiramis* Cope; *a*, *b*, cranium from side and above; *c*, mandible from above. Natural size. From the John Day epoch, Oregon. Original. From Report U. S. Geol. Survey Ters. F. V. Hayden.

The teeth of this genus differ from those of Perognathus in being without distinct roots, and in having the enamel loop cut off and inclosed. In Dipodomys the molars are undivided simple prisms.

The skull is compact and does not display the vacuities or large foramina seen in some genera of Rodentia. There are deep pterygoid fossæ, whose inner bounding laminæ unite on the middle of the palatine border and whose external laminæ are continuous with the posterior extremity of the maxillary bone. The otic bullæ are not separated very distinctly from the mastoid. The latter looks like a continuation of the former, as in Thomomys, and occupies considerable space between the exoccipital and the squamosal. The latter sends downwards a process just posterior

to the auricular meatus, which forms the handle to a hammer-shaped laminar bone. This is, no doubt, a dismemberment of the squamosal, as a similar process is continuous with that bone in Thomomys, and one somewhat different is seen in Neotoma, Hesperomys, &c. Supraoccipital distinct on superior face of skull. Paroccipital process small or none. Mastoid elongate, adherent to the otic tube. No postfrontal process.

A well-marked character which distinguishes the skull of this genus from Thomomys, Dipodomys, &c., is the separation of the meatal tube of the otic bulla from the zygomatic process of the squamosal bone by an interspace. There is no postsquamosal

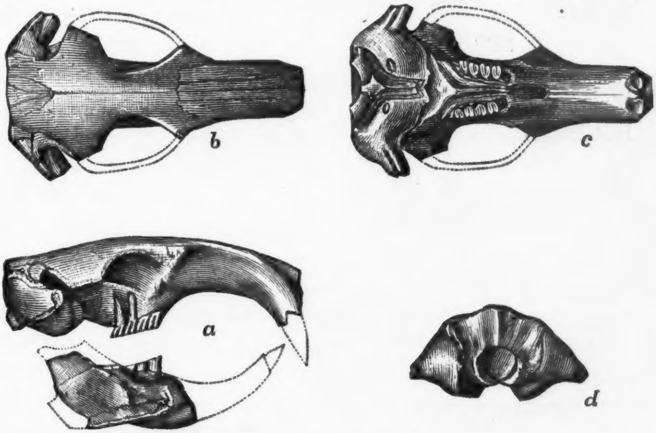


FIG. 18.—*Entoptychus planifrons* Cope; skull, side, top, bottom, and posterior views. Nat. size. In fig. *a* the roots of two molars are exposed. From John Day epoch, Oregon. Original.

foramen in the recent genera. In Dipodomys the otic bulla is more largely developed, but it has the anterior bottle-neck prolongation seen in Entoptychus.

Individuals of this genus were very abundant in Oregon during the middle Miocene epoch. They represent several species, but how many it is difficult to determine. The most noteworthy variations are found in the development of superciliary ridges; then there are modifications in the forms of the premolar teeth, differences in the length and width of the muzzle, and some range in dimensions. In *E. crassiramis* Cope (Fig. 17), there is a deep frontal groove which is closed posteriorly. In *E. cavifrons* there are strong and in *E. lambdoideus* there are weak, superciliary

ridges. In *E. minor* and *E. planifrons* (Fig. 18), the frontal bone is flat, and *E. minor* is smaller than the other species.

PALÆOLAGUS Leidy.

With this genus we enter the Lagomorpha, or rabbits, and their allies. It is probable that rabbits were as numerous in species in Miocene times in North America as they are at present, but the number of extinct species yet known is smaller than the recent.

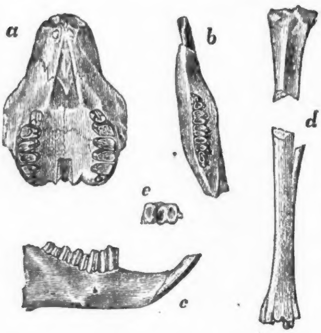


FIG. 19.—*Palæolagus haydeni* Leidy, natural size, from the White River beds of Colorado. *a* anterior part of cranium from below; *b* mandible from above; *c* do. from external side; *d* tibia; *e* distal end of do. from below. Original.

The characters of Palæolagus approximate nearly those of the existing genus Lepus. The only distinction between them signalized by Dr. Leidy, is the more simple first inferior molar of the extinct genus, which consists of one column more or less divided. In Lepus this tooth consists of two columns, the anterior of which is grooved again on the external side in the known species. I am able to reinforce this distinction by a strong character, viz., the absence of the postfrontal process in Palæolagus. As compared with the extinct genus Titanomys of Meyer,[1] the difference is well marked, as that genus has the molar teeth $\frac{5}{4}$ instead of $\frac{6}{5}$. The last inferior molar is cylindric, consisting of but one column. The first inferior molar consists of two cylinders broadly united, as in the corresponding tooth of Palæolagus. As compared with Panolax Cope,[2] which is only known from superior molar teeth, this genus may be at once recognized by the simplicity of the last tooth. In Panolax it consists of two columns. (See Fig. 19.)

Dr. Leidy's descriptions and figures, which are available for the definition of this genus, relate exclusively to the dentition. Characters drawn from the skeleton give some available indications. The condyles of the humerus are more primitive than those of the species of Lepus, in having a less developed intertrochlear crest. The tibiotarsal, or ankle joint, is, on the other hand, as

[1] Amphilagus. Catal. Méth. et Descr. Vertebès Fossiles de la Bassin de la Loire, 1853, p. 42.

[2] Report Lieut. G. M. Wheeler, 4to, IV, p. 296.

mechanically perfect as in Lepus. The extremity of the fibula is coössified, and the astragalar grooves are deep. This is a contribution to the evidence that the posterior feet of the Mammalia have advanced more rapidly in advancing evolution than the anterior. As the posterior limbs furnish most of the energy, and therefore sustain most of the shocks in progression, there is doubtless a connection between the two facts, of cause and effect.[1]

A cast of the cranial chamber of a specimen of *Palæolagus haydeni* displays the superficial characters of the *brain.* As in the order generally, the hemispheres are small and are contracted anteriorly. The greater part of the cast of the cerebellum is lost, but enough remains to show that it was large. The olfactory lobes are large; they are not gradually contracted to the hemispheres, but expand abruptly in front of them, being separated by a constriction only. They are wider than long and than the exterior part of the hemispheres. Their cribriform surface is wide, and extends backwards on the outer sides. Traces of the three longitudinal convolutions can be observed on the hemispheres above the lobus hippocampi. The internal and median are continuous at both extremities, and extend with the external to the base of the olfactory lobes. There is no definite indication of the Sylvian fissure. The lobus hippocampi protrudes laterally a little beyond the border of the external convolution. Its form is depressed.

As compared with the brain of the rabbit *(Lepus cuniculus)* figured by Leuret and Gratiolet, that of the *Palæolagus haydeni* is distinguished by the absolutely much smaller size of the hemispheres, and by the absolutely larger olfactory lobes, the excess being in transverse dimensions and not in the longitudinal. An important difference is also the absence of the median posterior production of the hemispheres seen in the rabbit, the prolongation in the extinct species being lateral, and extending little behind the lobus hippocampi. The indications of the convolutions of the superior surface are similar in the two.

As observed by Leidy, this genus presents the same number of teeth as in the existing rabbits, viz, I. $\frac{2}{1}$; C. $\frac{0}{0}$; M. $\frac{6}{5}$; and that the difference consists in the fact that the first molar possesses two columns, while in Lepus there are three. Having collected a

[1] See On the effects of Impacts and Strains on the feet of Mammalia, AMER. NATURALIST, 1881, p. 543.

great number of remains of this genus, I am able to show that it is only in the immature state of the first molar that it exhibits a double column, and that in the fully adult animal it consists of a single column with a groove on its external face. The dentition undergoes other still more important changes with progressing age, so as to present the appearance of difference of species at different periods.

The succession of teeth in the *Palæolagus haydeni* is as follows (Fig 20):

The earliest dentition of this species known to me is the presence of the two deciduous molars, the first and second in position, before the appearance of any of the permanent series. Each of these has two roots, and the crown is composed of three lobes. In the first, the first lobe is a simple cusp; the two following are divided into two cusps each; the second is similar, excepting that the simple cusp is at the posterior end of the tooth. The grooves separating the lobes descend into the alveolus on the outer side, but stop above it on the inner.

In the next stage, the third permanent molar is projected, and has, like the second deciduous, a posterior simple column, whose section forms an odd cusp or lobe. The fourth true molar then follows, also with an odd fifth lobe behind. This lobed form of the molars is so different from that of the adult as to have led me to describe it as indicating peculiar species under the name of *Tricium avunculus* and *T. annæ.*

In the next stage, the fifth small molar appears in view, and the second permanent molar lifts its milk-predecessor out of the way. In a very short time, the posterior, or odd, columns entirely disappear, sinking into the shaft, and the permanent molars assume the form characteristic of the species. The last stage prior to maturity sees the first milk-molar shed, and the younger portion of the first permanent molar protruded. There is the merest trace of a posterior lobe at this time, and that speedily disappears. The anterior lobe is subconical, and is entirely surrounded with enamel. By attrition, the two lobes are speedily joined by an isthmus, and for a time the tooth presents an 8-shaped section, which was supposed to be characteristic of the genus. Further protrusion brings to the surface the bottom of the groove of the inner side of the shaft, so that its section remains in adult age something like a B.

The *Palæolagus haydeni* was dedicated by Dr. Leidy to Dr.

Hayden who discovered it. It was an extremely abundant species, and no doubt furnished much food for the Carnivora of the Lower Miocene period. There are two other species found in the same horizon, the *P. turgidus* Cope (Fig. 20), and *P. triplex* Cope, both larger than the *P. haydeni.* The former is as large as the northern hare, *Lepus glacialis,* and had the teeth much like those of the *P. haydeni.* The *P. triplex* is of similar dimensions, and has the third column to the permanent molars which characterize the immature stage of the other species.

FIG. 20.—*Palæolagus haydeni* Leidy, temporary dentition. *a* two inferior milk molars; *b* two temporary and one permanent superior molars; *c–d* two temporary inferior molars about to be replaced; other permanent molars in place. Natural size. From the White River beds of Colorado. Original.

A species of the size and appearance of the *P. haydeni* is found in the John Day beds of Oregon, and a similar one occurs in the Loup Fork beds of New Mexico. As nothing but teeth of these animals are known, nothing can yet be finally determined as to their specific affinities.

PANOLAX Cope.

In this genus the last superior molar consists of two columns; otherwise the superior teeth are as in the last genus. The single species known, *Panolax sanctæfidæi* Cope, was as large as the northern hare. It is found in the Loup Fork formation of New Mexico.

LEPUS Linn.

Dental formula: I. $\frac{1}{1}$; C. $\frac{0}{0}$; P-m. $\frac{3}{2}$; M. $\frac{3}{3}$. First superior molar simple; first inferior molar with two external grooves; last inferior molars consisting of two cylinders. Postorbital processes present.

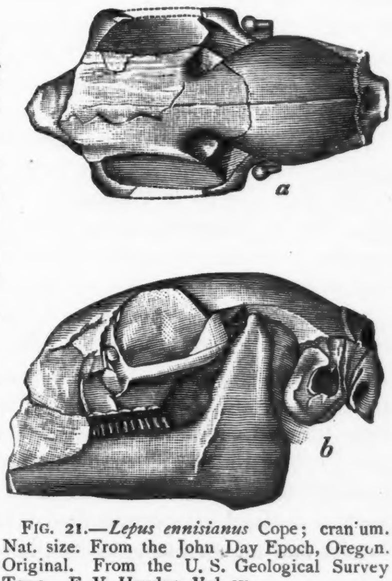


FIG. 21.—*Lepus ennisianus* Cope; cranium. Nat. size. From the John Day Epoch, Oregon. Original. From the U. S. Geological Survey Terrs. F. V. Hayden, Vol. IV.

I am acquainted with but one extinct species of this genus, and this is from the John Day Middle Miocene period. It proves the ancient origin of this genus, now so widely distributed over the earth. Species of Lepus are reported by M. Gervais from the Miocene (Montabuzard) and Pliocene (Montpelier) of France.

The Oregon species is ***Lepus ennisianus*** Cope, an animal about the size of the "cotton tail," ***Lepus sylvaticus***. (Fig. 21.)

(To be continued.)

——:o:——

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The excellent after-dinner speeches at the farewell banquet given to Herbert Spencer, Nov. 9, 1882, have been published by D. Appleton & Co., under the title "Herbert Spencer on the Americans, and the Americans on Herbert Spencer." Our readers would do well to read the brochure. One of the speakers, however, besides assuring Mr. Spencer that he stood at the head of the philosophers of his time, an opinion which we heartily endorse, also unequivocally asserted (see p. 75) that Spencer's writings on evolution (his "Psychology" published in 1854 and anonymous articles published in 1882) has an "incontestible priority to all other promulgations of recent evolutionary doctrine," and that the theory of evolution was elaborated "before Mr. Charles Darwin had ever published a word upon the subject."

Now we feel so cordially and sympathetically towards Mr. Spencer that we hope his last resting place (though be the time far distant!) may be in Westminster Abbey, by the side of Darwin. But a philosopher as such has not brought about the present attitude of the scientific and lay mind towards the doctrine of evolution. This was reserved for a naturalist, the author of the "Origin of Species," who began, as he tells us, in 1837 to accumulate his facts and to draw his inductions from observed or recorded facts, his theory of derivation having previously been suggested during his voyage along the coast of South America. It is the triumph not of an *a priori*, synthetic, or "cosmical" philosophy, but of the inductive method of natural science, that the scientific and popular thought has been revolutionized. Mr. Spencer evolved his general theory of evolution, broad, comprehensive and all-embracing as it is, in his study. Darwin circum-

navigated the earth, constantly observing wherever he went; and at home observed, always observed, out-of-doors. Compare Herbert Spencer's Biology (1866–71) and Darwin's "Origin of Species" (1859) and the very essence and methods of the two works are fundamentally unlike. The "Biology" is a collection of general principles in very general and often vague language, with a few facts gleaned from the writings of naturalists, while the "Origin of Species," whether or not we adopt the author's view of natural selection as a *vera causa*, is the leaven which has leavened the whole lump of modern thought. Among philosophers and metaphysicians we hear of Spencerism; among working naturalists we hear of Darwinism. In short, the general acceptance of the doctrine of evolution has been due to causes acting from without—to the actual study of living forms of life, of external, objective nature, and not from within, not from the inner consciousness. And this grand result of purely scientific work gives a dignity and importance to the studies of the biologist, which now commands the respect and consideration of every philosopher as such. A naturalist has been the architect of his own philosophy, and a Darwin has remodeled the philosophy of his age.

—— It is not consistent with the genius of the American people to restrict the progress of scientific knowledge by legislation or otherwise. The anti-vivisectionists, or beastiarians, succeeded in seriously hampering physiological research in England, and endeavored to stultify their intelligence by driving it entirely out of the kingdom. In this they happily failed. It is not unlikely that similar attempts may be made in this country, especially in localities where physiological research has its few and poorly rewarded votaries. Frightful stories will be circulated as to the cruelties of the vivisectors, and the statements of (?) able scientists will be adduced to the effect that vivisection is of no benefit to science.

But the discussion, though opened in the realm of sentiment, has come down to the region of fact. Vivisection is just as essential to the progress of physiology as any other form of experimentation is to the science to which it relates. The pain it inflicts is undoubtedly less than that which it ultimately prevents. The amount of pain it causes may also be easily exaggerated by persons unfamiliar with the subject. There are other directions in which benevolent people may reduce the amount of suffering in a perfectly legitimate manner. The enormous number of birds and other animals destroyed for the adornment of ladies' hats, bonnets and hands, is an unnecessary waste of animal life; and the sports of the chase are by no means free from cruelty. There is also probably a great deal too much meat eaten by many people. If people of benevolent inclinations would devote themselves to teaching the laws of nature to the ignorant, they would probably diminish human suffering more than by any other method.

—— A French committee for the propagation of the doctrines of evolution, is hesitating whether they shall call the subject of their teaching Darwinism or not. We are not surprised at their hesitation. Lamarck knew a good deal about evolution, but was not as well treated by his countrymen as Darwin has been by his. It is much better to be distinguished in England than in any other country. It is an amiable quality of the people of that fast little Isle to elevate well the angle of observation of their leading men, and to use good lenses in looking at them. This is an example which other nations should not be slow to follow, in scanning their own particular tract of the heavens.

——:o:——

RECENT LITERATURE.

GEIKIE'S TEXT-BOOK OF GEOLOGY.[1]—Aside from the immediate economic importance of the study of geology, the ultimate facts of the science, particularly those standing on the border-land of that science, that ill-definable territory between science and philosophy, into which the inquiring and speculative mind of man peers, and which so powerfully appeals to his mythic instincts—it is these ultimate facts and theories in geology which render it, like its sister science of astronomy, so attractive, and yield to many minds so absorbing an interest. Geology is an inexact science, and will remain so forever, or at least while our finite minds have failed to solve the problems of the first beginnings of our planet, while the nebular hypothesis is only a guess; while the lowest platform of life lies only as far down as the Cambro-Silurian horizon, when it should perhaps be placed at the base of the Laurentian, and while our science has failed to settle the question whether the Laurentian and Mont-Alban metamorphic rocks were azoic or eozoic, and while palæontology is silent as to the earliest types of vertebrates, and even of the ancestral forms of our own species. So long as problems like these are unanswered, geology will claim the interest of the best spirits of our race.

No single text book can well present the principles of this many-sided science. Lyell's Elements and Juke's Manual became antiquated over a decade ago, and while Dana's Manual of Geology is, with some limitations, the most comprehensive work the English-reading student can find, one needs even more than one authoritative hand-book to refer to. The American student will find just what he needs in the excellent manual before us; as the references to points in American geology and palæontology, though not particularly full, yet give it additional value to the American reader.

This volume of 971 pages is somewhat in the same vein, if we

[1] *Text Book of Geology.* By ARCHIBALD GEIKIE, LL.D., F. R. S., Director-General of the Geological Survey of Great Britain and Ireland, etc. With Illustrations. London: Macmillan & Co., 1882. 8vo, pp. 971, $7.50.

may use a geological simile, as De la Beche's Geological Observer and Juke's Manual, but is naturally rather more comprehensive. It is an expansion of the author's article, "Geology," in the "Encyclopedia Brittanica."

The comprehensive nature of the work will be seen by the titles of the books and parts into which it is divided. Book I. Cosmical aspects of geology. II. Geognosy—An investigation of the materials of the earth's substance. Part I. A general description of the parts of the earth. Part 2. An account of the composition of the earth's crust—Minerals and rocks. III. Dynamical geology. Part I. Hypogene action—An inquiry into the geological changes in progress beneath the surface of the earth. Part 2. Epigene or surface action. IV. Geotectonic (structural) geology; or the architecture of the earth's crust. Part I. Stratification and its accompaniments. 2. Joints. 3. Inclination of rocks. 4. Curvature. 5. Cleavage. 6. Dislocation. 7. Eruptive (igneous) rocks as part of the structure of the earth's crust. 8. The crystalline schists as part of the architecture of the earth's crust. 9. Ore deposits. 10. Unconformability. V. Palæontological geology. VI. Stratigraphical geology. Part I. Archæan. 2. Palæozoic. 3. Mesozoic or secondary. 4. Cainozoic, or Tertiary. 3. Quaternary, or Post-tertiary. VII. Physiographical geology.

It will be seen by the exhibit that the treatment is catholic and broad. The accomplished author is naturally strongest on general geological topics, but we would like to have had rather more space devoted to palæontology. In this department the illustrations are neither remarkably fresh or striking, nor are they always well printed. The lithological portion is excellent and fresh in its treatment. In Book I the references on p. 28, and also on p. 421, to the Gulf Stream, which is said to flow into the Gulf of Mexico, and to Croll's statement that this stream is the main agent of transfer of heated water from the tropics to the northwestern coast of Europe, would not probably have appeared had the first part of the book not been printed before the results of the recent explorations of the U. S. Coast and Geodetic Survey had been published, though Commander Bartlett's paper in the Journal of the American Geographical Society appeared about a year ago. Dr. Croll's hypothetical stoppage of the Gulf stream to account for the glacial climate of Northern Europe is not warranted by palæontological facts, as it has been shown that the marine quaternary fauna of the eastern coast of the United States, while arctic from New York northward, was semi-tropical at Charleston, S. C., and hence the Gulf stream must have existed throughout the quaternary period; besides this, according to Dr. Carpenter, there is a general movement of warm surface-water northward in the Atlantic ocean, the Gulf stream not being the sole agent of the transfer northward of tropical heated water.

So extremely hypothetical, from palæontological considerations, is the evidence of so-called "interglacial periods," referred to on p. 29, that we wonder that our author should endorse Dr. Croll's speculations without stating some of the facts supposed to sustain such a view.

The age of the earth is, from facts relating to erosion, set down as "not much less than 100,000,000 years since the earliest forms of life appeared upon the earth, and the oldest stratified rocks began to be laid down;" this length of time, from the standpoint of physics, as advocated by Sir William Thompson, is the same, while Tait's estimate of fifteen or twenty millions is given, although based on "results confessedly less emphatic than those derived from the facts of erosion, of physics and of tidal retardation."

The author treats of the upheaval of land under dynamical geology, but reserves his brief discussion of the mode of elevation of mountain chains and of continents for the section on physiography; we should think all these subjects would come under the head of dynamical geology. Neither has he apparently availed himself of Darwin's and Mr. A. Agassiz's facts concerning the secular rise of the South American continent. He devotes less than a page to the grand theme of the evolution of the American continent; and in this part of the book we feel that Professor Geikie has not risen to the grandeur of the subject.

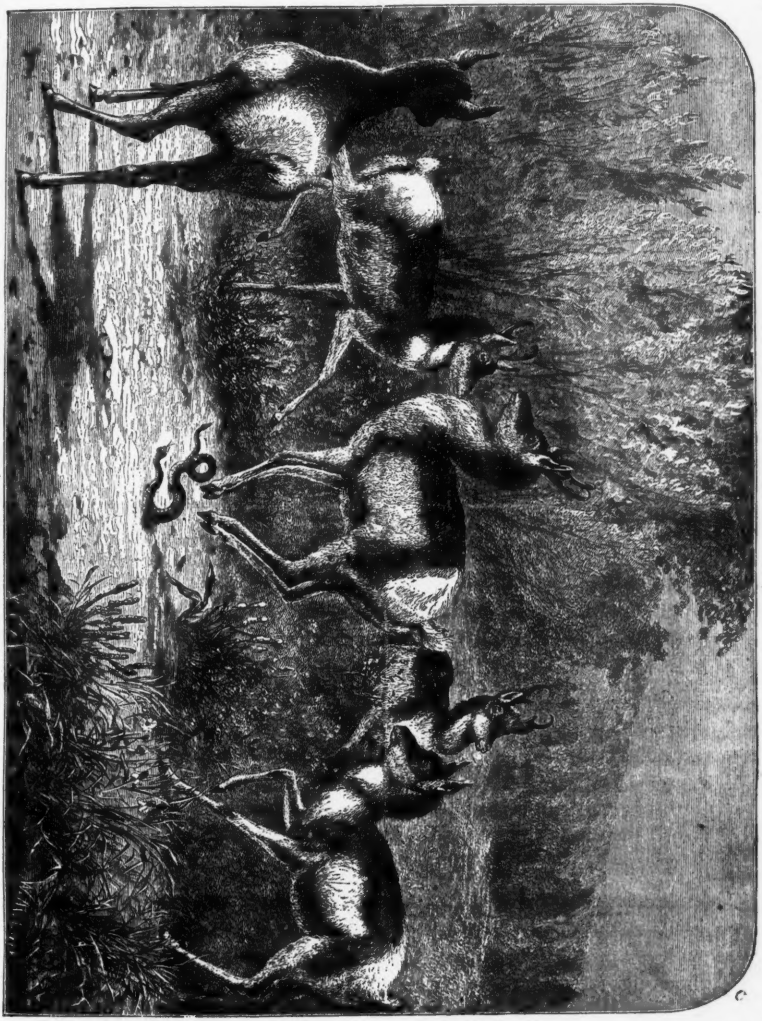
The care and elegance of the author's style; the generally excellent and apt illustrations; the typographical appearance of the book, allow little or no room for criticism. One geographical blunder is hardly excusable, especially as it is about a place in British possessions, though apparently inevitable in British authors (on p. 732, where "Canada" should read St. John, N. B.). On p. 801, after "Colorado," should be added the words, "and Wyoming."

While this Text-book of Geology does not, like Lyell's Elements and Principles, inculcate a great doctrine in geology, such as uniformitarianism; nor, like Dana's Manual, tell the story of the evolution of a continent, yet it is written in a graceful, attractive style, and presents in a comprehensive and sensible way the ground facts of the science.

INGERSOLL'S KNOCKING ROUND THE ROCKIES.[1]— This rather jaunty title sufficiently expresses the sketchy and fragmentary nature of an entertaining series of spirited sketches of nature and life in the Rocky mountains. Mr. Ingersoll was in 1874 attached to Dr. Hayden's U. S. Geological and Geographical Survey of the Territories, and afterwards made other trips to Colorado, accounts of which were contributed to *Harper's Magazine* and other

[1] *Knocking round the Rockies.* By ERNEST INGERSOLL. Illustrated. New York, Harper & Brothers, 1883. Large 8vo, pp. 220. $2.

periodicals and newspapers. These he has gathered into this volume, adding a number of excellent illustrations which add



Pronghorn Antelopes killing a Rattlesnake

materially to the interest of the book, making an admirable holiday present to a boy of sixteen. For here we have the romance as well as the stern realities of wild life in the West; traveling

and hunting on the plains, seeking for gold in the cañons, bear-hunting and exploring on the mountains, and glimpses of Indian and of military life at reservations and army posts. The sketches are true to life, and are much better reading for youth than the ordinary hunting romances which are written by the successors of Captain Mayne Reid. The illustrations are capital, particularly those engraved on wood. The accompanying engraving of pronghorns killing a rattlesnake by jumping upon it, is a fair example of the illustrations. The author refers to it without, however, describing the incident. Particularly good also are the sketches entitled "shooting the bighorns," that representing a fight between an elk and a buffalo, and another depicting the tragic result; the full-page illustration of a group of mule deer is good, while all the illustrations, as well as the press-work, are excellent. Mr. Ingersoll is an ornithologist, and scatters through the book sketches of his feathered friends.

FLOWER'S FASHION IN DEFORMITY.[1]—That some of the fashions of the highest civilization of the present day are dependent on grave deformities of the body, almost goes without saying. The hideous fact is only relieved by the knowledge that most if not all savage and barbarous peoples have their fashions, which are only more exacting and unaccountable than those of the European races. The wearing of earrings has descended to us from our savage ancestors. The bandaging and strange deformity of the head still practiced in France in the neighborhood of Toulouse, and common in many parts of the continent, and even observed in England within the memory of living people, and which produces an elongated and laterally constructed form of the head, is the same in kind with the more marked deformities produced by the Flat-head Indians and the ancient Peruvians. Professor Flower shows that the present high-heeled style of lady's shoe is only less injurious in its effects than the Chinese lady's foot, and that the pointed shoes worn by men likewise injure the shape and usefulness of the foot. Perhaps, however, the most grave and alarming deformity has been reserved for the highest civilization and for the feminine leaders of society; we refer to the wearing of tight corsets. The effects of this practice are too well known, but a glance at *Harper's Bazar* for September, teaches us that tight-lacing was never more demanded by fashion than now. The admirable and judicious little work of Professor Flower calls fresh attention to the fact that in admiring the constricted waist of ladies and the symmetrically pointed shoes of men of fashion, "we are opposing our judgment to that of the Maker of our bodies; we are neglecting the criterion afforded by nature; we are departing from the highest standard of

[1] Nature Series. Fashion and Deformity, as illustrated in the customs of barbarous and civilized races. By William Henry Flower, LL.D., F.R.S., etc. With illustrations. London: Macmillan & Co., 1881. 12mo, pp. 85. Price, 75 cents.

classical antiquity; we are simply putting ourselves on a level in point of taste with the Australians, Botocudos, and Negroes. We are taking fashion and nothing better, higher or truer, for our guide."

CATALOGUE OF THE BATRACHIA SALIENTIA OF THE BRITISH MUSEUM. SECOND EDITION.[1]—This most recent of the series of catalogues of the collection in the British Museum will prove invaluable to batrachologists, who have long felt great need of such a condensation of their united labors. Since the issue of the first edition of this work, a great number of new forms have been discovered, and the British Museum collection has tripled in the number of specimens during the last twenty years. The classification followed is principally that of Cope—the Phaneroglossa are divided by their sternal characters into Firmisternia and Arcifera with their families, while the Aglossa are separated into the families Dactylethridæ and Pipidæ.

The Firmisternia include both the toothless and toothed forms with firmly united sternum, whilst the Arcifera are also made up of toothed and toothless forms, the presence or absence of teeth being considered subordinate to the characters drawn from the sternum. The group of Bufoniformia is thus not recognized. The families adopted are almost entirely those of Cope, with the exception that the Scaphiopidæ and Pelodytidæ are united with the Pelobatidæ. Two new families, the Dyscophidæ and Amphignathodontidæ are defined by Mr. Boulenger.

This is undoubtedly the best systematic work on the *Batrachia anura* yet published. We think the author, if a second edition is called for, will modify his work in the following respects: Firstly by the adoption of the genera characterized by the degree of ossification of the cranial bones. This will divide his Hyla into four genera, viz.: Hyla, Scytopis, Osteocephalus and Trachycephalus. It will introduce a number of genera of Cystignathidæ, and strengthen the definitions of those already adopted. There is no sound reason for neglecting these characters, as they are quite as constant as any of those adopted by Mr. Boulenger, such as the palmation of the fingers and toes, the parotoid glands, etc. Secondly, he will probably adopt as a genus that form of Hylidæ which has the pollex present and represented by a sharp spine, which has been named by Brocchi, Ptectrohyla, but which is equivalent to Wagler's long prior Hypsiboas, which name was used for it by Cope, who first defined the genus.

MATERIAUX POUR L'HISTOIRE PRIMITIVE ET NATURELLE DE L'HOMME.—This anthropological journal, published at Toulouse, France, under the direction of M. Emile Cartailhac, has now

[1] *Catalogue of a Batrachia Salientia, s. Ecaudata*, in the collection of the British Museum, Second Edition. By GEORGE ALBERT BOULENGER. London. Printed by order of the Trustees. 1882.

reached its sixteenth year. In it appear the discoveries made in various parts of western Europe, especially those of southern France, and among its list of contributors are the well known names of Mortillet, Saporta, Daubree, Perot, Ribeiro, and Desor. As an example of the ground covered by this monthly journal, the perusal of which is essential to every American anthropologist who truly intends to be in the forefront of the army of advance, some of the contents of the issue for November, 1881, are here given.

Historical Review of the Working of Metallic Mines in Gaul, A. Daubree; Grouping of the populations of America according to the termination of the names of the towns, Comte Regis de l'Estourbillon; Notice of some prehistoric stations and monuments of Portugal (twenty-two figures), Carlos Ribiero; Antique sepulchre of Ceretolo near Bologna, Italy, H. A. Hazard; Earlier numbers contain accounts of the existence of an age of bronze in southern Russia, especially in the Caucasus, and of some prehistoric necropoli of the Caucasus containing microcephalic crania, both by Ernest Chantre. Thirty-one engravings illustrate these articles.

KINGSLEY'S NATURALIST'S ASSISTANT.[1]—Beginning with rather brief instructions for collecting and preserving mammals, birds, reptiles, batrachians and fishes, terse directions are then given as to the preparation of skeletons. The directions for collecting and preserving insects are good, but could in some respects be improved. In killing moths either in the net or when at rest either is very useful; both the insect-nets (Figs. 4 and 5) are drawn too shallow; the breeding cage (Fig. 11) does not seem to us to be very convenient, though very simple, and the door is made much too small. The section on dredging and marine collecting is well prepared, as is the second chapter on labeling and mounting specimens. Chapter third relates to the plans for a college museum and the arrangement of rooms and cases, and the suggestions are excellent; especially the suggestions for the arrangement of vials, which are so extensively used. It might have been added that as vials are apt to lose their alcohol, and the specimens consequently dry, they can be securely kept in large bottles filled with alcohol; otherwise they need to be filled once or twice a year. The chapter on the microscope is good, though brief, as is that on the laboratory; under the last head the author would have done well to have referred to aquaria in general, and the best mode of arranging series of small fresh-water and marine aquaria, such as every laboratory should be equipped with. The book closes with excellent directions for laboratory work, such as dissecting, injecting, section cutting, but no directions are given

[1] *The Naturalist's Assistant.* A Hand-book for the collector and student, with a Bibliography of fifteen hundred works necessary for the systematic zoölogist. By J. S. KINGSLEY, Boston, 1882. S. E. CASSINO. 12mo, pp. 228, $1.50.

for mounting the microscopic preparations when made; rather an omission. The list of 1500 works and articles on systematic zoölogy is well classified and selected, and we do not notice any omissions of importance. This naturalist's assistant is on the whole a timely and useful work, and we can recommend it to beginners, students, teachers and curators of museums as a very handy book. There is no book of the sort in the market.

BICKNELL'S SUMMER BIRDS OF THE CATSKILLS.[1]—In the preface to this work, the author remarks that many important facts relating to the ornithology of the Appalachians generally rest solely upon the authority of Audubon and Wilson. To aid in working up this important region, Mr. Bicknell spent three successive summers in the southern Catskills in the neighborhood of Slide mountain (4205 feet), the highest of the range. The list includes ninety species, among which are the whip-poor-will and eight out of the ten thrushes which belong to the eastern faunal province. The summits have a Canadian fauna, but the true Alleghanian fauna predominates, passing into the Carolinian at the lower part of the Hudson valley.

Among mammals, the porcupine (Erethizon) is abundant and stupidly tame about the highest mountain summits. No tortoises were noted, and only three species of serpents were seen. The memoir is carefully written, and is an able contribution to distributional zoölogy.

FILHOL'S NOTES ON SOME FOSSIL MAMMALS.[2]—The exploitation of the phosphatic chalk of Quercy continually brings to light new facts. In the present volume M. Filhol gives additional notes upon Ælurogale, Hyænodon, Pterodon, Cynodon, and other previously described forms, and describes several new species of Carnivora and Ungulata. Among the new forms are a species of the genus Oxyæna, furnishing another link between the tertiary fauna of Europe and America, a species of Cephalogale, one of Cynodon, and three of Galecynus *(Cynodictis)*. Stenoplesictis, a doubtful genus with somewhat musteline characters, furnishes two species. Among the ungulate forms, *Mixtotherium cuspidatum* is perhaps the most remarkable. Others are *Mixochœrus primævus*, *Amphimeryx parvulus*, *Deilotherium simplex*, and *Spaniotherium speciosum*, all described from portions of the jaws. M. Filhol concludes with some remarks upon the humerus, femur, tibia, and astragalus of *Adapis parisiensis*, showing that these bones prove that Adapis was closely related to existing lemurs.

M. Filhol's descriptions are as usual, excellent. We cannot praise his skill in name-composition, especially in those cases

[1] *A Review of the Summer Birds of a part of the Catskill mountains.* By E. P. BICKNELL.

[2] Mémoires sur quelques Mamiféres fossiles de Phosphorites du Quercy. Par M. H. Filhol.

where he uses the names of French localities in conjunction with Greek roots in forming generic names.

SYNOPSIS OF THE CLASSIFICATION OF THE ANIMAL KINGDOM. By H. Alleyne Nicholson, M.D., Ph.D., F.L.S., F.G.S., etc.[1]—We confess to a good deal of surprise at a work of this kind being put forth at this time. A more lamentable failure to fulfill the promise raised by the title page and general style of mechanical execution, it would be difficult to imagine. The work being simply a classified list, should at least have represented the results of modern investigation as to the systematic relations of animals. This the work in question does not do. The figures are good. The best is that of the *Pheronema annæ* of Leidy, which, however, is represented under the name of *Holtenia carpenteri.*

RECENT BOOKS AND PAMPHLETS.—A Review of the Summer Birds of a part of the Catskill mountains, with prefatory remarks on the faunal and floral features of the region. By E. P. Bicknell. Ext. from the Trans. Linnean Soc. of N. York. From the author.

Development of the planula of Clava leptostyla Ag. By J. H. Pillsbury. From the author.

Memoires sur quelques Mammiferès Fossiles, des Phosphorites du Quercy. Par M. H. Filhol. Toulouse. From the author.

Etude des Mammiferès fossiles de Ronzon (Haute Loire). Par M. H. Filhol. From the author.

Contributions to the Anatomy of Birds. By R. W. Shufeldt, M.D. Ext. from the 12th annual report of Hayden's Survey. From the author.

Congrès Geologique International. Compte Rendu de la 2d session. Bologne, 1881.

Ueber Flugsaurier aus dem lithographischen schiefer Bayerns. Von Karl A. Zittel. From the author.

Fossiles de la Pampa. Amerique du Sud. 2 Catalogue de Santiago Roth, San Nicolas. From the author.

Catalogue and Index of the publications of the Smithsonian Museum, 1846 to 1882. From the institution.

Notes on Fishes observed about Pensacola, Florida, and Galveston, Texas, with description of new species. By David S. Jordan and Chas. H. Gilbert. Ext. from Proc. U. S. National Museum. From the author.

Phonetics of the Kayowe language. By Albert S. Gatschet. Read before the Amer. Assoc. Adv. Sci., Aug. 19, 1881. From the author. Also by and from the same—

Linguistic Notes.

Footprints found at the Carson State Prison. By H. W. Harkness, M.D. Ext. from the Proc, Cal. Acad. Sci. From the author.

On certain remarkable Tracks found in the rocks of Carson quarry. By Joseph LeConte. Ext. from the Proc. Cal. Ac. Sc., 1882. From the author.

Observations on the fat-cells and connective tissue corpuscles of Necturus. By Simon H. Gage. Rep. from the Proc. Amer. Soc. Micros., Vol. IV. From the author.

---

[1]Wm. Blackwood & Sons, Edinburgh and London. 8vo, pp. 130, 1882.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

CIRCUMPOLAR STATIONS.—The Swedish expedition, after two unsuccessful attempts to land at Mussel bay, Spitzbergen, reached the shore with great difficulty at Cape Thordsen, in Ice fiord, and erected magazines and an observatory there. Observations began August 15, 1882. The state of the ice during the summer was unusually bad, and no vessels could get higher than Amsterdam island.

The Finnish party at Sodankylia, in the north of Finland, also began to make observations on August 15.

The Austrian expedition was also at first unsuccessful in its attempt to reach Jan Mayen, and the *Pola* had to put back to Tromsö, but made a second attempt, and anchored in Mary bay on July 13th. Besides the buildings brought out in the ship, two others were erected from driftwood, which was found in large quantities. There was little snow upon the island, but much ice outside, so that the *Pola* was compelled to go out to sea three times to avoid it. The station is situated on the so-called isthmus, which connects the northern and southern parts of the island, forming a valley through which flows a glacier stream. Its approximate position is in 71° N. lat., 3° 26′ E. long. The valley has been named after Count Wilczek. Regular observations were commenced on Aug. 7th. Fogs and rain prevailed from the beginning of July to the middle of August, and the thermometer seldom rose above 3° Celsius, and occasionally fell below freezing-point. An attempt was made to ascend the remarkable volcanic peak of Beerenberg, but after nine hours hard toil the party were compelled to give it up, having attained an altitude of only 5000 feet. Hot sulphurous steam issued from fissures, and extensive layers of lava were found. The *Pola* left Jan Mayen August 16th.

The party at the U. S. station at Point Barrow passed the winter of 1881-82 comfortably, and the observations were taken regularly.

The *Neptune* failed to reach the Greeley Scientific Expedition stationed in Lady Franklin bay, 31° N. lat., and has returned to St. John's, Newfoundland.

An impenetrable barrier of ice prevented her from reaching a higher latitude than 79° 20′, but she landed supplies at several ports, including Pandora harbor, where a record left by Sir Allen Young was discovered close to the water's edge, to which spot it had been washed down from a cairn above. Upon Brevoort island a record of Sir Geo. Nares was found. Upon one occasion the *Neptune* narrowly escaped crushing, and was saved only by the softer ice around the ship. From the precautions that have been taken in the concealment of the provisions, it is thought

[1] This department is edited by ELLIS H. YARNALL, Philadelphia.

that there is no danger of the U. S. observing party being in straits for want of food.

The Polar Committee of the Berlin Geographical Society have sent Dr. Koch to establish meteorological observations among the missions of the Moravians in Labrador, along the coast of which the line of minimum of depression passes. He arrived August 10.

When the *Germania* left Kingawa, in Cumberland sound, on September 6th, the observatory was completed, and observations had been commenced. A meteorological station has also been established in the Falkland islands, as an intermediary between the stations on the South American continent and that on South Georgia. Capt. Seeman reports that work has begun.

The meteorological expedition to the mouth of the Lena (Russian) has started on board large boats provided with all necessaries for building and wintering.

The Norwegian station at Bornekop, on the Alten fiord, commenced operations on August 1st.

DANISH ARCTIC EXPEDITION.—The *Djimpha*, with the Danish expedition under Lieut. Hovgaard, left Tromsö on the 2d of August. Lieut. Hovgaard's theory is that two large continents or groups of islands extend from Franz Josef land across the North Pole, in the direction of Wrangell island, and that they are separated by one or more straits which connect the Siberian and Palæocrystic seas, the principal opening being probably between Cape Chelyuskin and the New Siberian islands. The principal objects of the expedition are, to decide whether Franz Josef land really extends to the neighborhood of Cape Chelyuskin, whether the conditions of currents and ice are such that a base for further exploration can be reached without incurring too great a risk, and finally, whether the coast of Franz Josef land trend northward at that point to form the western side of this supposed great opening.

The *Djimpha* is 150 tons burden. The company includes a lieutenant and zoölogist, and numbers eight officers and fifteen men. Lieut. Hovgaard preferred to winter near Cape Chelyuskin or on the south coast of Franz Joseph Land. Observations were to be taken throughout the winter, in accordance with the programme of the International Expeditions.

The *Varna* and *Djimpha* were ice-bound eighty miles to the east of Waigatz island before September 21st, and this, together with the experience of the *Neptune*, appears to indicate an unusually severe arctic winter.

ARCTIC ITEMS.—The Italian antarctic expedition, under command of Lieut. Bove, who, with his staff, has now arrived at Genoa, was engaged in scientific observations in the Straits of Magellan, during the early part of last summer, but unfortunately their vessel was wrecked before very much had been accomplished.——The land on the shores of the Gulf of Bothnia is

gradually rising. One point, which in 1755 was only two inches above the level of the sea, is now six feet five inches.——Two Swedish geologists have undertaken a thorough geological examination of Bjornö and the southern part of Spitzbergen. Zoölogical and botanical observations have also been made.——The Swedish Geological Expedition returned to Tromsö on Sept. 16th. It was found impossible to land on Beeren island, as was intended, owing to tremendous seas. Snow had covered Spitzbergen as early as August 30th, and forced them to discontinue their researches. Observations were commenced at Smith's observatory, by the Swedish Meteorological Expedition, on August 15th.——Owing to the enormous quantities of drift-ice in the Kara sea, the *A. E. Nordenskiöld*, bound for the Jenisei, has put back to Vardö, after narrowly escaping being frozen in near Waigatz island.——An expedition under Lieut. Andreyew, sent out by the Russian Geographical Society, has reached Novaya Zembla, where it will winter.

Scientific Results of the Jeannette Expedition.—A history of the Jeannette expedition is in preparation, under the care of Mr. Raymond L. Newcomb.

The extensive collections of birds and deep-sea fauna were lost with the ship, but the observations of the aurora and magnetism, about 2000 measurements, were preserved. The depth of the ocean north of Wrangell island, where the Jeannette spent the first winter, was every where very small—thirty fathoms on an average, with a maximum of sixty and a minimum of seventeen fathoms. The bottom was usually a blue ooze, with a few shells, and sometimes with stones which seemed to be of meteoric origin.

On May 17, 1881, the small island called Jeannette, was reached in 76° 47′ 28″ N. lat., and 157° 20′ 45″ E. long. It consisted of a rocky hill, covered with snow, flanking the eastern side of a high mountain. Two days later, another island was discovered towards the west, and was named Henrietta. Mr. Melville landed on it on June 3d, 1881. It is 77° 8′ N. lat., and 157° 43′ E. long. It is rocky, and 2500 to 3000 feet high. The rocks are covered with nests of birds. Only one phanerogamous plant was found; all remaining vegetation consisted of lichens and mosses. A large glacier reaches the sea on the south coast, and the surface of the land is covered with ice and snow, fifty to a hundred feet in thickness. The highest latitude reached was 77° 42″ ten days after the abandonment of the *Jeannette*, in consequence of the drift of the ice upon which the escaping crew were journeying. Bennett island was discovered July 9th, during the retreat of the party to the Siberian coast. It is in 76° 38′ N. lat. and 148° 20′ E. long., and is a high mass of basalt covered with glaciers. On the north coast are several valleys covered with grass,

where reindeer bones and driftwood were found. Lignite, amethysts and opals were obtained, and fossils collected, but afterwards lost. The tides were regular, but very small—about two or three feet. The sea was free of ice to the west and south, and in the northwest a water-way was seen. The fauna and flora of the New Siberian islands, which were never before explored in the summer, promises interesting results. The observations made by the search expeditions may also be expected to furnish important corrections of the maps of the Siberian coast between the Olenek and Yana rivers.

Geographical Notes.—The well-known French explorer of South America, Dr. Jules Crevaux, who was recently killed by Indians in the Gran Chico, had just begun the exploration of the Pilcomayo, that great tributary of the Paraguay, which, it is hoped, will afford an important means of communication between Bolivia and La Plata.——Mr. Colquhoun, of whose proposed journey from Canton to the Irawadi mention has previously been made, reached Bhamo, by way of Western Yunnan, but was unable to carry out his original plan of crossing the southern part of Yunnan and the Shau States to Rangoon. He has, however, explored a long and heretofore unknown route in Southern China.——The highest mountain in the Philippines, a volcano called Api, has been recently ascended by two German naturalists, and ascertained to be 10,824 feet above the sea-level. ——From operations with the spirit-level, in connection with the Indian tidal observations, it has been deduced that the ocean level at Madras is three feet higher than at Bombay, an anomaly which has been found to be caused by an accumulation of minute errors due to the fact that, when the general direction of the lines of levels is towards the sun, or opposite to it, the observer gets a side view of the bubble refracted obliquely through the thickness of the glass tube, and is thus inclined to regard the outer edge of the rim of the bubble at the end nearer the light, and the inner edge of the rim at the other end, as the bubble itself. Thus the instrument is assumed to be level, when in reality the end towards the light is depressed. This error, when measured and multiplied by the number of stations at which it would occur between Madras and Bombay, gave about three feet.——The changes of level of the rivers of Russia, in Europe, have been accurately measured. The highest range is reached by the Oka, at Kalaga, and is 45 feet, while the average range along the entire length of the same river is 32.2 feet; the average for the Volga, from its source to its mouth, is 33.6 feet; for the Kama, 30.1 feet; for the Duna, 25.2 feet, and for the Don, 23.1 feet. Even at Astrakhan the Volga has a range of 12 feet, and the Duna one of 9 feet at Riga.——In 1880, M. de Saussure suggested the probability that the level of Lake Leman is now lower than formerly, and recent investigations of the superficial drift have led

to the conclusion that in former times, during the present era, the lake must have been at least three meters higher than its present level.——M. Lessar has returned from Saraks, whither he journeyed through the flat country called the Altek, inhabited chiefly by Tekke Turcomans, except two villages occupied by Persian Shiites. Most of the natives live in clay houses, and subsist by agriculture.——Dr. Otto Finsch has returned to Berlin, after two and a half years in Polynesia and Australia. He has visited the Sandwich, Marshall, and Caroline islands, also New Britain, New Zealand, Australia and Tasmania, as well as the islands in Torres straits and the south coast of New Guinea, where he stayed six months, and instituted comparisons between the Papuans and Eastern Melavesians. He brings a rich collection, and is accompanied by a native of New Britain, aged 15.

GEOLOGY AND PALÆONTOLOGY.

The Sediments of the Gulf Stream Slope.—Professor Verrill states that the bottom of this slope, in from 70 to 300 fathoms, 60 to 120 miles from land, is mainly formed of very fine quartz sand, intermixed with feldspar, mica, magnetite, etc., and with a considerable percentage of foraminiferous shells. Spherical, rod-like and stellate sand-covered rhizopods also often occur in large quantities. The sand is often so fine as to resemble mud, and in the deeper localities true clayey mud may be met with, yet as a whole the region is characterized by the prevalence of fine sand, and the absence of mud, a circumstance which appears to indicate the presence of a current sufficient to prevent the deposition of mud along the upper portion of the slope.

Throughout the belt, even to over 700 fathoms, occur numerous pebbles and small rounded boulders of granite, syenite, mica-schist, etc., that have probably been dropped from shore ice that has floated out into the Gulf stream.

At several localities concretions of a peculiar calcareous rock, varying in size from a few inches in diameter up to twenty-nine inches long, fourteen wide and six thick, were dredged up. Professor Verrill believes these to be of deep-sea origin. They differ much in color and fineness of grain, but are all composed of siliceous sand cemented together by lime in greater or less abundance.

No rocks of this kind are found on the coast, and it is scarcely possible that marine currents sufficiently powerful to erode them exist at these depths, but Professor Verrill thinks it possible that their detachment may be due to the habits of certain fishes and crustacea. The hakes (Phycis) root in the mud like pigs for annelids and other mud-dwelling invertebrates; the Macruri burrow into the bottom tail first; the eels are all burrowers, and so are many crabs. The action of these creatures would enable the currents to wash away the finer materials, and leave the coarser.

Shells, broken and unbroken, are very abundant in many places. The broken shells have probably been preyed upon by such Cancroids as *C. borealis* or Geryon, or the larger Paguridæ; and many fishes break the shells of the mollusks they devour. On the other hand many fishes, as the cod, haddock, hake, etc., swallow shells entire, digest their contents, and discharge the shells uninjured, and the same is the case with star fishes. Sponges and boring annelids prevent the great accumulation of molluscan remains.

Vertebrate bones, whether fish or cetacean, are very rare, and it is probable that the bones as well as the flesh of all vertebrates that die are speedily consumed by the life at the bottom. A few clinkers, fragments of coal and ashes from the steamers, are the only traces of man.

FILHOL'S FOSSIL MAMMALS OF RONZON.[1]—The calcareous marls of Ronzon, near Puy, have during the last thirty years furnished numerous mammalian remains. The beds belong to the earliest miocene, and are not only rich in mammals, but contain species of birds, reptiles and fishes, as well as of insects, crustacea, and mollusks. Notwithstanding this diversity, M. Aymard, who was the first to describe these mammals, remarks that, since few really terrestrial species occur in these palustral beds, and since the species found must have been accompanied by other forms suitable for their food, it may safely be said that the remains discovered are only a small part of the fauna of the early miocene age in France. The great artiodactyle *Anthracotherium*, is found in other beds of the same epoch, yet all the other species, *Theridomys aquatilis*, *Hyænodon leptorhynchus*, *Elotherium magnum* and *Gelocus communis* excepted, are peculiar to this locality. Only one insectivore, *Tetracus nanus*, has been found here, and the rodents, Theridomys excepted, are not well known.

Remains of carnivores are numerous, but belong only to five or six species, and M. Filhol remarks that the numerous ungulates found seem to indicate the existence of more and larger carnivores. With the exception of two species of Hyænodon, the carnivores are small. The coprolites of Cynodon show it fed principally upon small vertebrates, while bones belonging to animals of this genus bear the marks of the powerful teeth of larger carnivores by which they had been devoured. From its broad feet and long tail, Cynodon appears to have been an habitual swimmer in the basins that have furnished the deposits. The marsupials are represented by some small species, most of which belong to the genus Peratherium. These strata are the latest in which the genus Palæotherium occurs.

M. Filhol states that, although he has long studied these remains, he has principally used materials collected by other naturalists, and especially by M. Aymard, and makes no claim to more than a résumé of all that has been done in the locality.

[1] Etude des Mammiferes fossiles de Ronzon. (Haute Loire.) By M. H. Filhol.

New Mammalia from the Puerco Eocene.—Professor E. D. Cope recently read a paper before the American Philosophical Society, in which he described nine new species of vertebrates from the above horizon, and extended the characters of several species previously little known. All are Mammalia excepting one species of serpent, which was named *Helagras prisciformis*. Its vertebræ present the peculiarity of having the zygantrum open on each side of the middle line so as to expose the angles of the zygosphen. The projecting median part of the roof of the zygantrum remaining, forms a process which Professor Cope named an *episphen*. This character represents an incompleteness of the zygantrum appropriate to the antiquity of the species, which is the oldest known snake from North America. A new genus of Mammalia was named *Mixodectes*. It was regarded as intermediate between Cynodontomys, and the Eocene half-lemurs. Two species, *M. pungens*, and *M. crassiusculus* were named. The other new species are, *Triïsodon levisianus*, *Phenacodus calceolatus*, *Mioclænus meniscus*, *M. bucculentus* and *M. ferox*. The last species is the largest of the genus, probably equaling a wolf in size. Both are represented by considerable parts of the skeleton, and these possess the general characters of the Creodonta. The dental characters would refer the genus to the Arctocyonidæ. Two species, (*M. brachystomus* and *M. etsagicus*), from the Wasatch Eocene, have been referred to this genus, on account of the technical identity of the dental characters. These characters are also the same in the genus Pantolestes, which has been referred to the Mesodonta, but without knowledge of the skeleton. Now it has been demonstrated that the *Mioclænus brachystomus* is an artiodactyle. It can therefore no longer be referred to Mioclænus, and as the dentition is identical with that of Pantolestes, it may, with the *M. etsagicus* be placed in the latter genus. Pantolestes must then be provisionally arranged with the Artiodactyla, although the skeleton of the type, *P. longicaudus* of the Bridger epoch, is unknown. This case illustrates the impossibility of deciding on the affinities of some Eocene mammalia by the dentition alone.—*E. D. Cope.*

Structure of Glaciers.—It is now known that the substance of glaciers is made up of crystalline grains (each grain a single crystal), which increase in size as the glacier descends. Swiss physicists differ as to the nature of this increase. Professor Forel attributes it to freezing of water of fusion that comes from the surface through capillary fissures. The mass cooled below zero in winter cannot rise to the temperature of zero in summer except by the latent heat liberated by water at zero, when it freezes in the heart of the glacier. On the other hand, Professor Hagenbach-Bischoff thinks M. Forel's theory inapplicable to the compact mass of the glacier proper (though it may explain the change of pulverulent snow into that of the *névé*, and the change of the

névé into ice). He considers the cause of the increase to lie in the *overcrystallizing* (Uebercrystallisiren) of one grain at the expense of its neighbor. The known fact that the melting temperature of ice is lowered by excessive pressure and raised by extension, accounts for the plasticity of a crystalline mass; water produced by fusion at points where the pressure is greater is transported and frozen at points of less pressure. It is further supposed that the crystals of ice present differences of compressibility in their different axes; hence crystals differently directed will have unequal power of raising or lowering the temperature of fusion under pressure, and some will tend to grow at the expense of others less favorably directed.—*English Mechanic.*

GEOLOGICAL NEWS.—Professor Zittel in the *Palæontographica* for 1882, describes and figures a number of species of the order Pterosauria from the Solenhofen slate of Bavaria. He corrects and increases our knowledge of the species *Pterodactylus elegans, Kochi* and *brevirostris*, and of the species of Rhamphorhynchus. He distinguishes three of the latter, *R. longicaudus, R. gemmingi*, and *R. muensteri* (= *R. phyllurus* Marsh).

BOTANY.[1]

NEW SPECIES OF NORTH AMERICAN FUNGI.—*Mitrula luteola.*—1½–3 centimetres high; head mostly compressed, ½–¾ of a centimetre wide, subplicate, light yellow; stipe shorter than the head, paler and tomentose, often slightly hollow; asci narrow, attenuated below, 90–100 × 5–6 μ. paraphyses none; sporidia uniseriate, elliptical, or often slightly bulging on one side, faintly 1–2 nucleate, yellow, when discharged on paper: 6–7 × 2½–32μ Solitary or subcespitose. On the ground among fallen pine leaves in sandy pine woods. Newfield, N. J., Oct., 1882.

Peziza (*Mollisia*) *incrustata.*—Gregarious and often sub-confluent, sessile or contracted below into a very short stipe; disk immarginate convex, scarcely becoming concave, when dry, honey color, pruinose, appearing as if covered with fine crystals of sugar, about $\frac{1}{6}$ mm. in diameter; asci clavate contracted below into a slender base, 30×3½–4μ. paraphyses filiform, simple or branched, sporidia partly biseriate, ovate-oblong, simple, hyaline, 5–6 × 1 μ. On some old resupinate Polyporus, on the under side of a trunk of *Juniperus virginiana* lying on the ground. Newfield, N. J., June, 1882.

Dermatea juniperina.—Erumpent sessile, orbicular, sooty black, disk slightly paler when moist, margin obsolete, about ¼ mm across, contracted below when dry, so as to appear substipitate; asci clavate, cylindrical, 100–114 × 15–18 μ.; paraphyses filiform, scarcely thickened above; sporidia subbiseriate, elliptical, nearly hyaline, with a large central nucleus, 18–20 × 7–12 μ. On dead

[1]Edited by PROF. C. E. BESSEY, Ames, Iowa.

or dying leaves of *Juniperus communis.* Decorah, Iowa, May, 1882. E. W Holway.

Bulgaria Ophiobolus.—Cespitose, obconic, subinfundibuliform, ½–¾ of a centimeter high and broad, composed of two layers, separated by a gelatinous stratum, pruinose and dark olivaceous outside, disk nearly black, margin obtuse, entire; asci cylindrical, $150 \times 10–12 \mu$. paraphyses filiform; sporidia vermiform-cylindrical, multinucleate, curved or bent, rather narrower at one end, $40–75 \times 34 \mu$. When dry, scarcely distinguishable, externally from *B. inquinans* Fr. On a decaying log. Decorah, Iowa, Sept., 1882. E. W. Holway, No. 280.

Tympanis bicolor.—Cespitose or single, sessile, narrow subundulate margin and outside pale rufous, disk black, nearly plain, $\frac{3}{4}–1^{mm}$ in diameter; asci subcylindrical, $75 \times 8–9 \mu$.; paraphyses, stout, not distinctly enlarged above; sporidia, mostly uniseriate, oblong-elliptical, often narrower at one end, 2–4 nucleate, yellowish, $13–15 \times 3\frac{1}{2}–4 \mu$. Nearly allied to *T. acerina,* Pk. On dead limbs of (maple?) Decorah, Iowa, Aug., 1882. E. W. Holway, No. 220.

Hysterium sphaeriaceum.—Erumpent minute, $\frac{1}{4}–\frac{1}{3}^{mm}$ long, by ⅔–¾ as wide, densely gregarious, black and nearly smooth, but not polished, opening narrow, lips not prominent; asci subcylindrical, nearly sessile, 55×7; paraphyses obscure; sporidia biseriate fusiform, hyaline and nucleate, becoming yellowish and 3 septate, and often slightly constricted at the septa, $12–20 \times 3–3\frac{1}{2} \mu$. The perithecia are mostly sparingly clothed with pale, short, weak, sub-glandular hairs. Much resembles *Glonium parvulum* Ger, but the fruit is very different. On decaying wood. Decorah, Iowa, Aug. 23, 1882. E. W. Holway, No. 223.

Hypoxylon Holwayii.—Stroma ¼–½ centimeter in diameter, rather thin, orbicular, black within, surface covered with a white pruinose coat, except the projecting, acutely papillose, black ostiola; perithecia, in a single layer, 20–30 in each stroma; asci cylindrical; sporidia uniseriate, oblong, brown, 1–2 nucleate, $22–27 \times 11 \mu$., resembling the spores of a Sphaeropsis. Surrounding the stromata and standing out obliquely like a coarse fringe, are short coarse black bristle-like teeth, like the teeth of a Hydnum or Irpex. This curious growth also arises from the surface of the inner bark, for some distance around the stromata, soon throwing off the epidermis, and leaving the blackened surface of the inner bark exposed. This growth is analogous to that of *Institale acariforme* Fr., in connection with *Hypoxylon coccineum.* On dead trunks or limbs of Populus. Decorah, Iowa, July 1882. E. W. Holway, No. 145.

Hypoxylon piceum.—Stroma effused, sub-elliptical, or elongated, often by confluence, forming patches 4–8 centimeters long, by half as wide, dark brown, nearly black within, surface wrinkled, and covered with the dull yellow conidial growth, which also

spreads over the surface of the wood adjacent, and consists of short rudimentary irregularly branched hyphæ, which are thickly covered with the minute, dust-like conidia; perithecia, in two or three layers, densely crowded and angular by compression, the lower layer much elongated, ostiola minute scarcely visible: asci ——? sporidia navicular brown, 11–12 × 4. The stromata resemble blotches of black pitch dusted over with yellow meal, and are of about the consistence of beeswax. On rotten wood. Decorah, Iowa, Oct., 1882. E. W. Holway, No. 287. (Allied to *Hypoxylon crocatum* Mont.)

Nectria lasioderma.—Perithecia mostly single, subamorphous, obtuse-conic, broadly perforated above, $\frac{1}{4}^{mm}$ high, shagged with short, septate, obtuse, imperfectly developed hairs, dull red when dry, pale orange when moist; asci cylindrical, 75–80 × 7½; sporidia uniseriate, elliptical hyaline, uniseptate, scarcely constricted, 11–12 × 4–5 μ. Parasitic on old *Valsa lutescens* Ell. On dead limbs of *Quercus coccinea* lying on the ground. Newfield, N. J., June, 1882. On account of its small size and dull color easily overlooked.

Nectria Rexiana.—Perithecia minute, not over $\frac{1}{4}^{mm}$ in diam, flesh color, becoming black, slightly compressed laterally. Solitary or 2–3 together, enveloped in white down which forms little tufts, appearing under the lens like some minute, tufted mucedinous growth; asci linear, 35–40 μ. long, evanescent; sporidia uniseriate, oblong, hyaline, 1–2 nucleate (becoming uniseptate)? 5–6 × 1½–2 μ. Parasitic on *Chondrioderma spumarioides.* Adirondack mountains, N. Y., Aug. 1882. Dr. Geo. A. Rex.

Nectria truncata.—Perithecia gregarious, minute, $\frac{1}{10}$ – $\frac{1}{8}^{mm}$ in diameter; flesh color, subglobose, the apex flattened into a circular, granular roughened disk with the edge slightly projecting; ostiolum in the centre of the disk, minute, papilliform, brown; asci sublanceolate, 35 × 5; sporidia biseriate, oblong-fusiform, sub-hyaline, slightly constricted across the middle and uniseptate, 11–13 × 2½ – 3μ. Under the pocket lens resembles *Illosporium pallidum* Cke.

Melanconis apocrypta.—Perithecia subcircinate ($\frac{1}{3}^{mm}$) membranaceous, 8–12, buried in the inner bark without any distinct stroma, entirely concealed by the epidermis, which, without being ruptured, is raised into slight, whitish pustules by the pressure of the short fasciculate ostiola; sporidia 25–30 × 11–13μ, at first surrounded with a hyaline, gelatinous envelope, and more or less perfectly biseriate in asci 114 × 22μ, but at length becoming brown, uniseptate and uniseriate in elongated asci 120–150 × 12μ. On dead poplar branches. Decorah, Iowa, July, 1882. E. W. Holway, No. 164. The conidial stage is probably *Melanconium populinum* Pk. This is closely allied to *M. occulta* (Fckl.) Sacc., but differs in its narrower asci and smaller brown sporidia without appendages.

Melanconis (Melanconiella) Decoraensis.—Perithecias ubglobose, coriaceous, $\frac{1}{2}^{mm}$ diam. 8–12 circinating in a cortical stroma covered by the thick epidermis; ostiola scarcely prominent, united in an elliptical, erumpent, dirty gray disk; asci cylindrical, briefly stipitate, spore-bearing part 95–115 × 8–11μ; sporidia uniseriate, elliptical, and obtuse olivaceous, uniseptate, 15–20 × 8–10μ. The accompanying Melanconium mostly in a separate stroma with abundant pip-shaped olive black spores of about the same size as the ascospores On dead limbs of birch. Decorah. Iowa, Aug., 1882. E. W. Holway.

Cryptosporella lentaginis Rehm (in literis.)—Perithecia globose, $\frac{1}{2}^{mm}$ diam. membranaceous, mostly 3–4 together in a cortical stroma, their bases sunk into the subjacent wood; ostiola short, barely piercing the epidermis, which is raised into numerous little tuberculiform pustules; asci clavate-cylindrical, 45 × 7–8μ; sporidia biseriate, cylindrical, hyaline, straight or slightly curved, 11–12 × 2–2$\frac{1}{2}\mu$, with 2 or 3 minute nuclei. The substance of the bark is blackened by the mycelium. On dead *Viburnum lentago.* Decorah, Iowa, June, 1882. E. W. Holway, No. 119, partly.

Diatrype tiliacea.—Perithecia subelongated ($\frac{1}{2}$ × $\frac{1}{3}^{mm}$) buried in the scarcely altered substance of the inner bark, in clusters of 5–10 or more, their rough, conic or cylindric-conic ostiola bursting through the epidermis in compact clusters, but scarcely united in a disk; asci broad, oblong, 80–90 × 18–22μ; paraphyses? sporidia in 2 or 3 series or lying obliquely, 8 in an ascus, oblong-cylindrical, slightly curved, obtuse, hyaline, becoming uniseptate, slightly constricted in the middle with a single large nucleus in each cell, 22–30 × 7–8μ. The clusters of perithecia often longitudinally confluent, are surrounded by a faint circumscribing line visible only near the surface. The ostiola ($\frac{1}{2}$–1^{mm} long), are at length ruptured at their tips with a broad, irregular opening. The ascigerous nucleus is white. On bark of dead *Tilia americana.* Ames, Iowa, Oct. 1882. J. C. Arthur, No. 86.

Diatrype phæosperma.—Stroma small (1^{mm} diam.) tuberculiform, closely embraced by the imperfectly laciniate-cleft epidermis; perithecia 6–8, $\frac{1}{3}^{mm}$ diam. with thick coriaceous walls, lying in a single layer under the white stroma, which is circumscribed by a black line that scarcely penetrates to the wood beneath; asci (spore bearing part) about 55 × 7μ; sporidia imperfectly biseriate, cylindrical, curved, continuous, brown, 10–12 × 3–3$\frac{1}{2}\mu$, ends obtuse. Ostiola obtuse, black, not prominent, dotting the pale brown or wood-colored disk. On dead limbs. Decorah, Iowa, Aug. 1882. E. W. Holway, No. 228.

Diatrype radiata.—Perithecia membranaceous, 8–15, bedded in a light-colored tuberculiform stroma, which splits the epidermis in a laciniate manner, and is circumscribed by a black line, which does not, however, penetrate to the wood; ostiola obtuse, scarcely prominent; asci clavate, 75–80 × 6μ; sporidia cylindrical, yel-

lowish, curved, continuous, 9–12 × 2μ. The perithecia have thick walls, which are pale olivaceous at first, and at length black. On dead elm branches. Decorah, Iowa, Sept., 1882. E. W. Holway, No. 266.—*J. B. Ellis, Newfield, N. J.*

ENTOMOLOGY.[1]

MISTAKEN INSTINCT IN A BUTTERFLY.—I believe I have an instance in illustration of your remark in the NATURALIST for July, 1882, that "the sense of sight, touch and taste play a more important part in insect economy than the sense of smell."

In June I observed that a plant of *Artemisia ludoviciana* in our garden was covered with the hollow, spherical, leafy retreats of the larvæ of *Pyrameis huntera.* Never before having found this caterpillar on any plant except Antennaria, I thought that the very different qualities of the new food might possibly produce some variation in the butterfly, and so transferred a dozen or more of the skeletonized coverts to the rearing cage.

In so doing, I noticed that the larvæ seemed very small in proportion to the quantity of foliage gnawed. In the cage, although constantly supplied with fresh food and light and air, they did not thrive, and lingered along from day to day without any perceptible growth. Nor did those left on the plant in the garden develop much more satisfactorily, and one after another disappeared long before attaining full size. Of those in confinement but two succeeded in passing the third molt, and all died in about two weeks, from lingering starvation, except a couple that I transferred to Antennaria, which began at once to feed with avidity and soon completed their transformations.

As a rule, we can depend upon the botanical determinations of insects. I have repeatedly had the species of a plant, about which I was in doubt, decided for me by the peculiar gall or mine, which it bore, and which I knew to occur only on a certain species. In this case, however, the instinct of the parent butterfly was evidently at fault.

Antennaria being rather rare in this immediate locality, she was misled by the surface resemblance of the white, cottony leaves of the Artemisia to those of the accustomed food-plant of her young, and under this misapprehension deposited her eggs in utter disregard of the somewhat pungent odor, which a keen sense of smell would have perceived.

The young, upon hatching, attempted to feed, but found in the dry, bitter leaves of the Artemisia no adequate substitute for the bland, mucilaginous Antennaria, and, although they did not immediately die from its effects, were unable long to resist them.—*Mary E. Murtfeldt, Kirkwood, Mo.*

[1] **This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.**

OBSERVATIONS ON THE FERTILIZATION OF YUCCA AND ON STRUCTURAL AND ANATOMICAL PECULIARITIES IN PRONUBA AND PRODOXUS.[1]—This paper records some recent experiments and observations which establish fully and conclusively the fact that Pronuba is necessary to the fertilization of the capsular Yuccas. It describes for the first time how the pollen is gathered and collected by the female Pronuba. The act is as deliberate and wonderful as that of pollination. Going to the top of the stamen she stretches her tentacles to the utmost on the opposite side of the anther, presses the head down upon the pollen and scrapes it together by a horizontal motion of her maxillæ. The head is then raised and the front legs are used to shape the grains into a pellet, the tentacles coiling and uncoiling meanwhile. She thus goes from one anther to another until she has a sufficiency.

My observations confirm the accuracy of Dr. Geo. Engelmann's conclusion as to the impotence of the stigmatic apices in some of the Yuccas, and show how the apparently contradictory experience of Mr. Meehan can be reconciled on variation in this respect in the species of the same genus.

The exceptional self-fertilization in *Yucca aloifolia*—the only species in which it is recorded—is shown to be due to the fact that in the fruit of these species there is no style, the stigma being sessile, and the nectar abundant, filling and even bulging out of the shallow opening or tube. The flowers are always pendulous and the pollen falling from anthers can, under favorable circumstances, readily lodge on the nectar.

The irregularity in the shape of the fruit of the Yuccas—considered a characteristic by botanists—is proved by experiment to be due to the punctures of Pronuba.

The egg of Pronuba, which averages 1.5^{mm} long, having a swollen apical end, and a long and variable pedicel, is passed into the ovarian cavity of the fruit. The puncture is made usually just below the middle of the pistil on the deeper depression which marks the true dissepiment, or through the thinnest part of the wall. The horny part of the ovipositor reaches the longitudinal cavity at the external base of the ovule near the funiculus, without, as a rule, penetrating or touching the ovule itself; and the delicate and extensile oviduct then conveys the egg for some distance (the length of six or eight seeds) along the cavity, the terminal portion of the oviduct being furnished with retrorse hairs which help to hold it in place during the act.

The paper concludes with some studies of the internal anatomy of Pronuba and Prodoxus.

NATURAL SUGARING.—Lepidopterists have long found sugaring, *i. e.*, the besmearing of tree trunks with various, more or less intoxicating, sweets one of the best means of obtaining night-fly-

[1] Abstract of a paper, by Professor C. V. Riley, read at the Montreal Meeting of the A. A. A. S.

ing moths, but we do not recollect of seeing any record of what may be called natural sugaring. The year 1882 has been remarkable for the excessive abundance of a yet undescribed species of Lachnus, which we have called *Lachnus platanicola*, infesting the sycamore. We have received accounts of its excessive abundance from widely different sections of the country, as far north as Michigan and as far southwest as Missouri; while on trees in the grounds of the Department of Agriculture, it has prevailed to such an extent that whole trees, including leaves, branches and trunks, were heavily blackened by the growth of the fungus (*Fumago salicina*)[1] which developed on the saccharine exudations from the Lachnus. Hosts of sweet-loving insects, including all sorts of Hymenoptera during the day and chiefly Lepidoptera at night, were attracted to the trees which even excelled those artificially sugared as collecting ground for various Noctuids. The brilliant and glistening eyes of these moths, thickly settled upon all parts of the trees, gave these at night the appearance of being studded with gems, and produced an effect rarely witnessed, we imagine, by entomologists.

The comparatively sudden and excessive increase of a given species, as in this instance, over a wide extent of territory, is always remarkable and somewhat difficult to explain. We have observed that the conditions which permit such undue increase are often widely prevalent, and that species about the life-history of which little or nothing was previously known, are often studied by observers in different parts of the country during one and the same year.

The average expanse of the winged male of *Lachnus platanicola* is 14^{mm}, and length of body 4.5^{mm}. It bears a close resemblance to *L. longistigma* Monell, but is at once distinguished, among other differences, by its smaller size, paler wings and paler stigma. The apterous, oviparous, or true female has an average length of 8^{mm}. The eggs are about 2^{mm} long, elongate-ovoid, highly polished and sticky, orange-brown when first laid, but changing through olive-green to dark brown and finally almost to black. They covered the branches on the under side so thickly as to attract a host of different predatory insects which often cleared the branches with a regularity that was astonishing. —*C. V. Riley*.

EPILACHNA CORRUPTA AS AN INJURIOUS INSECT.—The plant-feeding habits of our common *Epilachna borealis* are well known, but nothing has hitherto been recorded of the food-habits of its Western congener, which, originally described by Mulsant from Mexico, extends to Colorado and Western Kansas. The very first notice we receive of the habits of this species shows that it is

[1] *Capnodium citri*, etc. See W. G. Farlow, on Diseases of Olive and Orange trees. *Bulletin Bussey Inst.*, and *Monthly Microscopical Journal*, 1876.

capable of doing serious injury, as will be seen from the following letter of Professor Geo. H. Stone, Colorado Springs, Col., dated Aug. 26th, and accompanied by numerous specimens of *Epilachna corrupta:*

"By this mail I send you a tin box containing larvæ and perfect beetles which promise to have almost as unenviable a reputation as *Doryphora 10-lineata*. From the egg to the grave they are voracious. They are good judges of food. With me they have confined their attacks to black wax beans, and the enclosed leaves and pods will show their mode of attack. The early broods ate nearly all kinds of vegetables in a neighboring garden. They are rapidly spreading in the vicinity. I judge there are two or three broods in the year, like Doryphora. The adult beetles are not quite so active as their ten-lined relatives, however. They do not drop when the plant is shaken quite so readily as the potato-beetle. I have had but little chance to study them, as they only appeared in my garden a few days ago. Within that time they have eaten almost every leaf on a good-sized patch of wax beans, and to-day I have made arrangements to have them all picked by hand so they shall not have a chance to hibernate."

Spread of the Twelve-Punctured Asparagus Beetle.—Mr. Otto Lugger of Baltimore, Md., has already recorded the recent introduction from Europe of a second asparagus beetle, the *Crioceris 12-punctata* Linn., which in Europe occurs commonly wherever asparagus is cultivated, without, however, doing serious injury. Mr. Luggar found it first in the summer of 1881 near Baltimore in small numbers and quite local, but it has recently proved even more troublesome than *C. asparagi*. From the latter species this new enemy may at once be distinguished by its less elongate form and by the bright orange-red of the upper surface, each elytron being marked with six small black dots.

Trogoderma tarsale as a Museum Pest.—Professor F. H. Snow publishes in *Psyche* (Vol. iii, No. 98) careful descriptions of the larva and pupa of this beetle so destructive to our insect collections. It is in fact the most common museum pest in this country, and it is strange that Dr. Hagen in his paper on Museum pests does not mention it. It is by no means peculiar to the West as Professor Snow seems to suppose. Here in Washington it is by far the most dangerous enemy to insect collections, and much more frequent than *Anthrenus varius*. In the field its larva is occasionally found in the cracks of hollow trees and similar situations, feeding on dead insects, but it is far more common in the deserted cells of Pelopaeus, Odynerus, Anthophora and other Hymenoptera that store their cells with spiders or other insects.

Phylloxera in California.—In a report made by Mr. John H. Wheeler, Secretary of the Viticultural Commission of California,

on the result of the examinations made by the commission we find the following facts clearly set forth:

1. In California, as elsewhere, *Phylloxera vastatrix* hibernates in the apterous female state on the roots; 2. The winter egg, if it exists at all, is as in the Eastern States, extremely rare on the wood above ground. Mention is made of finding occasionally dead bodies of females covering well developed eggs, and it is quite probable that these are the impregnated eggs produced by hypogean stem-mothers. It appears that the insect in California is most injurious in moist soils. In this respect, and this only, the experience on the Pacific coast seems to differ from ours on the Atlantic, for with us where normally there is an abundance of moisture the Phylloxera thrives best during dry summers. The opposite result in California is doubtless due to the fact that the conditions are there reversed.

Hearing in Insects.—The sense of hearing in insects has been recently studied by Herr Gruber. He found the cockroach (*Blatta germanica*) very sensitive. On sounding a violin note when a cockroach was running across the floor, the creature always suddenly stopped. Again, a number of these cockroaches were enclosed in a glass vessel, and on making a strong sound there was evident agitation and excitement; some would fall down from the glass as if paralyzed. A cockroach was hung by a thread from its hind leg; when it was quiet a bow was drawn sharply over the violin strings at the distance of about four feet, whereupon the insect was greatly excited, and struggled round, getting its head uppermost. Beetles also were readily affected by sounds, but grubs and ants gave no certain indications. Of aquatic insects various kinds of Corixa were tried. These would often remain quite quiet for several minutes, but on tapping the glass with a glass tube they rushed about in much agitation. A disk at the end of a long rod drawn to and fro in the water near a quiet Corixa produced no effect, but on conducting the sound of a struck bell into the liquid by the rod, there was lively reaction; similarly when a glass bell stroked with a bow, was brought to touch the water. These creatures were also sensitive to high violin notes in air, to the sound of a metal plate struck with a hammer, &c. Still more sensitive to sound were various aquatic beetles (Laccophilus, Laccobius, *Nepa cinerea*, &c.). On the other hand various larvæ, especially of Ephemerides, were unaffected; but these were sensitive to mechanical agitation of the water. Herr Gruber considers the response the insects made to sound an indication of true hearing, and not mere reflex action.—*English Mechanic.*

ZOÖLOGY.

Propagation of Sponge by Cuttings.—The Journal of the Society of Arts contains an abstract of an account given by Dr. E. V. Marenzeller of the efforts made by the Austrian government

to improve sponge culture in the Adriatic, from which the following is condensed:—Professor O. Schmidt expressed a conviction that if a perfectly fresh sponge were cut into suitable pieces, and these were again placed in the sea, they would grow, and in time become perfect sponges. This was put to the test by an experiment conducted in the Bay Socolizza, commenced in 1863, and concluded in 1872. Though success was rendered impossible by the determined opposition of the local populace, it did not prevent the accumulation of a mass of valuable information. The most suitable season for commencing the propagation is the winter. The growth of the sponge, and the healing of the cut surfaces, proceed much more slowly in winter than in summer; but a high temperature is dangerous, by reason of the great tendency of the sponge to undergo rapid putrefaction. As to locality, choice should be made of bays sheltered from strong waves and currents; but not quite still; the bottom should be rocky, and clothed with living algæ; and there should be a moderate ebb and flow of the tide. In all cases, the neighborhood of the mouths of rivers and subterranean springs must be avoided.

The freshness and liveliness of color of the marine algæ are sure indications of a suitable spot. The worst enemy of sponge culture is mud. The sponges chosen for cutting must be gathered by experienced hands, with all possible gentleness. They are removed either by tongs or by drag-nets.

At a low temperature in the cold season of the year, it is possible, with sponges freshly caught on the spot, to proceed at once to make cuttings from them, whilst during warm weather, it is necessary to wait and see whether any signs of putrefaction make their appearance. This reveals itself by the dullness and softness of the affected part. The dissection is rapidly performed, either with an ordinary knife, or better, with a fine saw-like blade, which is much less liable to injury by the foreign matters so abundantly found in sponge. The sponge is laid on a smooth wooden board, moistened with sea water. The size of the cuttings is usually about 26c. mil. (1 cubic inch). It is well that each cutting should have the greatest possible area of uninjured outer skin. The cuttings are placed directly in the spots where they are intended to resume growth. A healthy piece of sponge firmly attaches itself to any surface with which it comes into intimate contact in a short time. Cut sponges grow together again. The attachment takes place most rapidly when the pieces have but one cut surface, and this is laid upon the support-wood, stone, &c.

During perfect calm, for at least twenty-four hours, it is possible, according to Buccich, to plant the cuttings upon the stony sea-bottom itself, and they will hold. He saw pieces that were merely cast into the sea on an ordinarily suitable rocky bottom, during perfect calm, attached themselves and grow. Thus enlightened as to the natural habits of the sponge, Buccich prepared

stone slabs, 53^{mm} thick, as a foundation. These he perforated with holes, and fastened the cuttings to them by wooden pegs driven into the holes; but it became evident that the mud and sand of the sea-bottom, perhaps also excess of light, were inimical to further growth. Lattice frames having the form of floating tables above, and with the sponges attached beneath, were tried. Professor O. Schmidt also suggested merely tying the cuttings to strong suitable strings. By the first plan there was too much shade; by the second, too much light. Buccich first constructed an apparatus composed of two planks crossing each other at right angles, with a third as a cover. This was so far successful that the cuttings were exposed on all sides to the sea, and assumed the desirable round form. He then made a modification, consisting of two boards 63^{cm} by 40^{cm}; one forms the bottom and the other the lid, and they are held parallel one over the other at a distance of 42^{cm} by two short stays, some 11^{cm} apart. In the space between these stays stones can be placed as ballast. On the top of the cover is a handle. In both planks holes are bored at 12^{cm} apart. Buccich fastened the cuttings not simply on the apparatus, but on sticks which were driven into the holes of both boards.

As material for the sticks, the common Spanish cane was used, whose siliceous rind is proof against the attacks of the pile-worm. The sticks were 42^{cm} long, and bored through at a distance of 12^{cm}, the lower end being split. On each stick three sponge cuttings were fastened in such a manner that they should lie over the bore-holes; through these, wooden sticks were thrust, and each cutting was thus fixed.

When the sponge cuttings are to be pegged only with wooden nails, a triangular stilletto will suffice for piercing. When adopting the method of fixing by sticks, such an instrument is not suitable, because much too great force would be required to make an opening to admit the sticks. Forcing and squeezing causes a loss of sarcode, the minimizing of which is the first rule that governs all manipulations of sponge. Buccich bored the cuttings with an auger with toothed edges, 6^{mm} broad, fixed to a vertical wheel driven rapidly by a little pulley. While one hand quietly presses the sponge against the borer, the other turns the wheel. In a few seconds the operation is concluded; the bore-hole is clean, the fibres are not torn, and the sarcode does not run out. When a stick is filled with cuttings, its split end is thrust into one of the holes in the support, and a wedge is driven through the slit.

As each bottom and top takes 24 sticks, carrying three cuttings apiece, one such apparatus will accommodate 144 cuttings. During the whole manipulation, until the arranging of the sponges is quite complete, they must be repeatedly and gently moistened with sea-water, especially in summer. The apparatus may be most conveniently let down and pulled up by means of a small anchor. The depth may be 5 to 7 metres.

If the cuttings hold fast after three or four weeks, the propagation is secure. A characteristic feature of the cuttings is their tendency to assume a round form. To facilitate this on every side is the chief aim of Buccich's system of supporting on sticks. As to the rate of growth of the cuttings within a certain period no rule can be given, on account of the varying conditions.

Buccich remarked that the cuttings in the first year were two or three times as large as they were originally; he further remarked that the cuttings grew better in the first and fourth years than in the second and third, a point evidently regarded as doubtful by Dr. Marenzeller; and it would seem that though some specimens may have attained a considerable size in the fifth year of transplantation, still a term of seven years is necessary to produce a marketable and profitable article.

Dr. Marenzeller also mentions the fact that besides being beautifully formed and rounded, the cuttings retain these qualities, and perfect health, with increasing size.

In conclusion, Buccich proposes the question whether the undertaking can be made profitable, and answers it in the affirmative.

Dr. Marenzeller concludes that the propagation of sponge by cuttings is not to be recommended to people without capital, but is more suited to the attention of a capitalist, or an association of capitalists, and to be conducted on a large scale.—*Journal Royal Microscopical Society.*

The Circumpolar Distribution of Certain Fresh-water Mussels, and the Identity of Certain Species.—In a recent paper[1] suggested by the occurrence of the remains of fresh-water mussels (Anodons) associated with other fossils in the sedimentary strata of the Carson City prison yard, read by Dr. Stearns before the California Academy of Sciences, the author in an elaborate review of the subject, expresses the opinion that the European *Anodonta cygnea* + *Anatina*, should be added to the circumboreal list with other fresh-water mollusks, including *Margaritana margaritifera*, among the lamellibranchs, and *Limnæa stagnalis*, *L. palustris*, and *L. auricularia* (as represented by *L. ampla*); *Physa hypnorum* and *P. fontinalis* (by *Physa heterostropha*), among the gasteropods.

With the exception of *A. cygnea*, the above species have long been regarded by the most conservative authors as circumboreal in their geographical range.

The author also considers the Eastern American species, *Anodonta imbecilis* Say and *A. fluviatilis* Lea, from New England waters, inclusive also of *A. implicata*, from the same region as identical with *A. anatina* or some of the numerous varieties of

[1] "On the History and Distribution of the Fresh-water Mussels and the Identity of certain alleged species." By Robert E. C. Stearns. Proc. California Acad. Sciences, November 20th, 1882.

A. cygnea, of which Dr. Lea has listed no less than *one hundred and six synonyms.* As *A. anatina* is shown to be but a varietal or conditional aspect of *A. cygnea*, therefore these alleged American species are regarded as belonging to *A. cygnea.*

Dr. Stearns also includes in this identity with *A. cygnea*, the West American forms known heretofore as *A. nuttalliana, A. wahlamatensis, A. oregonensis,* and *A. californiensis;* these are traceable to Cygnea, through its Anatina aspect or condition, as well as through others of the many varieties of Cygnea, which have led to the extensive synonymy above referred to.

Specimens of *A. anatina*, from Regent's park, London, laid upon valves of *A. californiensis*, so-called, from Owen's river, California, he found to agree exactly in incremental lines and in final or peripheral outline.

He further shows how specimens of *A. cygnea*, at a certain stage of growth, would, if collected at the time when the shell had reached said stage, have been called Anatina, but not having been collected until said stage of growth had passed, became by subsequent growth Cygnea. The absurdity of regarding species thus made as valid, is self-evident.

The fresh-water mussels of the Colorado desert are associated with contemporaneous molluscan forms like Physa, Planorbis, Tryonia and Amnicola in the Carson City prison-yard, the same form (of mussel) is found with evidences of higher but extinct animal organizations like that of Elephas, a species of horse, a deer, a wolf, a wading bird, possibly the footprints of a human being, but more likely the tracks of a great sloth like Mylodon. The molluscan remains are identified by Dr. Stearns as belonging to Sphærium and Physa. The fresh-water mussels are the same as are now found living a few miles away in Washoe lake, and specimens from this lake are exactly like those from Bear river and Utah lake in Utah Territory, and further the specimens from these various points are closely like the Anatina aspect of *A. cygnea.*

The paper presents also reviews past and present geological and physico-geographical conditions, and assigns the Carson footprint beds to the uppermost tertiary.

The general tenor of the paper, which is quite lengthy, sustains Professor Weatherby's view as to the earliest fresh-water mollusca being lacustrine.

On the Eastern Range of Unio pressus (Lea).—This species was originally described by Dr. Lea, and figured (in Trans. Am. Phil. Soc., Vol. III, 1830, pp. 450–451, plate XII.) under the name of *Symphynota compressa*, from Ohio, and also from Norman's Kill, near Albany, where it was found by Dr. Eights. It has since been found in the northern canal at Troy, N. Y., by T. H. Aldrich; at the outlet of Owasco lake, by Dr. Jas. Lewis; and in a small

lake in Herkimer Co., N. Y., which empties over a rocky bed, with numerous falls into Mohawk river (May, 1877), by R. E. Call (vide AM. NAT. for July, 1878, p. 473). DeKay in his Mollusca of New York (p. 191), mentions receiving it from Sandy creek in Jefferson county, and from Oak-orchard creek in Orleans county. Professor C. B. Adams in his Fresh water and land Shells of Vermont (vide Thompson's History of Vermont, 1842, p. 166), says: "The species * * * has its eastern limit in the streams west of the Green mountains." He also describes under the name *plebius* Adams, a variety found in a small brook near Middlebury in that State. Mr. F. R. Latchford of Ottawa, Canada, informs me that the species has been found quite recently in the Rideau river by Mr. Tyrrell, of the Canadian Geological Survey; this is I think the most northerly point from which it has been obtained. I have just received it from Winooski river, at Winooski, Vermont, where it was found by Mr. Geo. H. Hudson. As Winooski is situated near the outlet of Winooski river, where it falls into Lake Champlain; and as Middlebury, the source whence Professor Adams obtained his specimens is located upon Otter creek, a stream flowing northerly into the same lake, it is not improbable that embryonic shells have been carried down to the lake by freshets, and that the species will be found inhabiting the lake in close proximity to the outlets of these rivers; with its northern connection, specimens may find their way to the St. Lawrence water system, and thus extend the range north and east. It seems probable that the species has been introduced to the Herkimer county lake in which Mr. Call found it, by the agency of water fowls, from some of the sources here mentioned, two of which lie within a radius of less than one hundred miles of the point in question.—*A. F. Gray, Davenport, Mass.*

BITHINIA TENTACULATA (LINN.).—This European fresh-water shell, first recorded from Oswego, N. Y., by Rev. W. M. Beauchamp (June, 1879), vide AM. NAT. for July, 1880 (p. 523), has been found recently (Sept., 1882), upon the wharves at Burlington, Vermont, by Geo. H. Hudson. It will thus be seen that the species has found its way into Lake Champlain, and may soon be looked for, if circumstances are favorable to its distribution, in the St. Lawrence water system, with which this lake communicates. In the Mohawk river, near Mohawk, N. Y., where the species was planted by the late Dr. Jas. Lewis, the species has become very abundant, it being more frequent in the bends of the river, where the water moves slowly.—*A. F. Gray.*

NEW LOCALITIES FOR LIMAX MAXIMUS (LINN.).—This European slug was found at Cambridge, Mass. (May, 1882), by Professor Alpheus Hyatt. It has more recently been found at Cincinnati, Ohio, where it was discovered in a cistern on Third street; the latter specimens were collected in the autumn of 1882, and are

now in possession of the Cincinnati Society of Natural History. The species was first discovered in this country by Mr. Samuel Powel in a garden at Newport, R. I., in 1868; it has also been found at Philadelphia and Brooklyn.—*A. F. Gray.*

A Blind Copepod of the Family Harpacticidæ.—The interest now centering upon these animals, which through peculiarities in their habitat have dispensed with important organs, may warrant the mention of a case of the disappearance of the eyes in an order of Crustacea in which it has not been hitherto noticed so far as I know.

While collecting marine Copepoda in the Gulf of Mexico a gathering was taken from a very slightly saline marsh, a ditch passing through the marsh affording the only water of sufficient depth in which to use the net. This ditch is about eighteen inches in breadth, but of moderate depth, and extends continuously for some distance; it is so shaded by high salt sedge grass as not to be found save by accident. The gathering here secured proved to contain a new species of the sub-family Longipediinæ and closely allied to the genus Bradya established by Boeck in 1872 for a marine Copepod dredged in rather deep waters about North Europe.

The American species, which has been named *Bradya limicola* in allusion to its muddy habitat, was found to lack in both sexes the pigmented eyes which in other Harpacticidæ are so conspicuous in the center of the forehead or on either side. It is to be regretted that lack of opportunity to repeatedly collect this interesting species, and to endeavor to ascertain if truly pelagic species also inhabit our waters, robs this discovery of much of its interest.—*C. L. Herrick.*

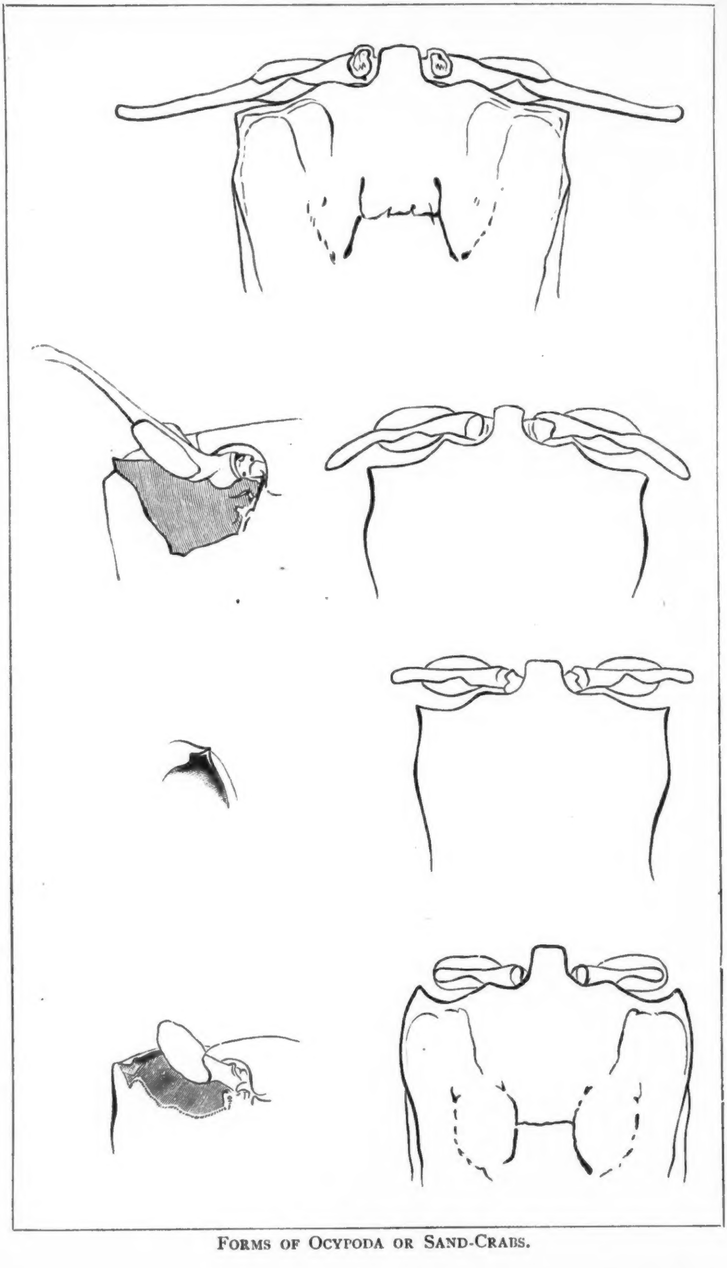
The Sucker on the Fin of the Heteropods is not a Sexual Characteristic.—The posterior margin of the "fin" of the three genera of Heteropoda, Pterotrachæa, Firoloides and Carinaria bears a small sucker-like body which many authors say is characteristic of the male of Pterotrachæa and Firoloides.

This structure is sometimes found on the fin of the female. Among a number of specimens of *Pterotrachæa coronata* Forskal, collected at Villa Franca, South France, I find a perfect female Pterotrachæa with this organ as well developed as in the males. I have also studied specimens of *Firoloides lesueurii* Eyd. Soul, in which ovaries were well developed where the sucker was present. Most observers agree in saying that Carinaria has the pinnal sucker in both sexes.

This organ is probably not confined to either sex in the above mentioned genera. Morphologically it may be regarded as a functionless organ or the remnant of a structure which in those Gasteropoda from which the Heteropods sprung was of great importance. The free-swimming habits which these active mollusks

MIAMI UNIVERSITY.

PLATE IV.



Forms of Ocypoda or Sand-Crabs.

have, caused its reduction to a rudimentary organ.—*J. Walter Fewkes, Cambridge, Mass.*

On the Origin of the Species of Ocypoda, or Sand-crabs, from the Bonin islands.—The species on which the following observations are made was obtained from the Bonin islands in the year 1880. It seems to be closely allied to *Ocypoda arenaria* Latr., described and figured by M. Edwards, in the Hist. Crust., Vol. II, Pl. XIX, Figs. 13 and 14,

Among numbers of specimens obtained, we can at once distinguish two widely different forms; the one with the eye-stalk enormously produced beyond the edge of the carapace, and the other with the normal eye-stalk. The former has the anterior border of the carapace wavy; the wave beginning with its highest point on the exterior angle of the orbit descends gradually outwards till it ends, with its lowest point, on the external angle, which is about 90°. The lateral edge forms a concave face externally for a short distance. The anterior gastric groove has its concave face internally

In the short-eyed form on the contrary, the same anterior border of the carapace is deeply concave anteriorly, the two forming an acute angle, which consequently points anteriorly. The anterior gastric groove has its convex face externally. Again a deep notch on the border of the orbit below, and near to the external angle of the carapace, is found to be entirely wanting in the former. Lastly the last abdominal somite but one is narrower in the former, and in the male, widened near the middle, but little posteriorly. The measurement of the whole abdominal somite shows similar proportions.

I will here annex the measurement of the somite from a female crab, in which the eye measures 11^{mm}, and the stalk beyond measures 8^{mm} side by side with the normal or the short-eyed form.

	Long-eyed.	*Short-eyed.*
The greatest width of the somite, last but one	20.3^{mm}	21.0^{mm}
The least width of the same	8.5 "	9.5 "
The greatest length do	11.0 "	10.0 "
The least length do	9.0 "	8.1 "

The following is the measurement taken from the entire somite:

	Long-eyed.	*Short-eyed.*
Length	35.5^{mm}	34.0^{mm}
Breadth	24.0 "	25.0 "

Similar differences of measurement occur also in the male, which I need not cite here.

Such great differences are, I think, enough to distinguish these two forms as two distinct species, had there not been a series of forms standing as stepping stones between them.

By the comparison of a number of specimens we detect a form

in which the eye-stalk is but slightly produced, appearing as a slight notch. Closer examination of this form will reveal to us that the anterior border of the carapace is less convex than in the short-eyed one, thus approaching somewhat to the long-eyed form. Sometimes, in others, we find a slight notch in the orbit in place of the deep one found in the short-eyed form, departing thus somewhat from the long-eyed form and approaching more to the short-eyed.

Of these various features, the eyes form the most important, for in them we have the complete series of intermediate forms beginning with the long-eyed to the short, The extraordinary length of the eye-stalk beyond the eye proper, is to be accounted for either as representing an embryonic form or as the further differentiation of the normal eye. Viewed in the former light, it may be supposed to have originated as an appendage upon whose basipodite the ocular differentiation has taken place. In this respect it accords with Professor Huxley's view, in so far that the eye is considered as an appendage, while it differs from the views of Claus and F. Müller, who deny the appendicular character of it. Whatever the views may be, we are quite certain that here in these forms we see the specific differentiation going on before our eyes. We do not know from the specimens before us whether all these various forms come from a single parent, or whether each had a parent like itself.—*C. Ishikawa, University of Tokio, Japan.*

HETEROGENESIS IN THE COPEPOD CRUSTACEA.—In a former paper we have considered examples of heterogenesis furnished by the Cladocera. Let us now turn our attention to the copepods, the *Cyclopoiclea*, with the view to discover if similar conditions exist here also.

The standard books upon the non-parasitic forms of the Copepoda by Claus[1] and Brady[2] enumerate many species, but do not agree entirely in synonymy, nor does it seem probable that, Claus, who alone has done most of the anatomical and embryological work in this section, has followed the life-history of anything like a large proportion of the species named.

It has been long known that the marine forms of Copepoda have a very extended geographical range, many of them seeming to complete the circuit of the earth's longitude and to extend over several zones of its latitude[3]. Similar and often identical forms occur in the Mediterranean and North seas, over all Europe and the British Isles. Certain genera, as Calanus and Chetochilus, seem to extend through all degrees of latitude from the equator to the most northern seas.

A confirmation of these facts may be sought in the works of

[1] C. Claus: Die Frei Lebenden Copepoden. Leipsig, 1863.
[2] G. S. Brady: Copepoda of British islands, Roy. Soc. 1878–9.
[3] Claus; Op. cit., pp. 83–86.

Claus, Dana, Leydig, Jurine, Baird, Fischer, Müller, Lubbock, Boeck, Brady, Heller, Lilljeborg, Sars, Uljanin, etc. As yet, however, it is too soon to say how far this similarity may extend.

Confining ourselves, for the present, to fresh-water forms, a recent opportunity for comparison of American with European Copepoda has confirmed our impression that a large number of species will be found identical[1]. It seems, indeed, somewhat astonishing at first to discover that the isolated pools of the Central United States contain species identical in every particular with those of England, Scandinavia or Germany, but such is certainly the case. In fact the populous genus Cyclops has few new species in America relative to the number identical with transatlantic forms.

A Diaptomus, believed to be identical with *D. castor* in typical as well as several varietal forms, occurs throughout Minnesota from the shores of Lake Superior to near its southern boundary and in Illinois. Another species believed to be nearly allied to a Scandinavian species is known from Minnesota, Wisconsin and the neighborhood of East St. Louis, Illinois. *Cylops serrulatus* Cls., with similar variations to those noticed by Claus (Op. cit., p. 85) and Brady (Op. cit., vol. 1, plate 22) occurs as our most abundant species.

It may be observed that Brady's work is so strictly systematic that his figures are frequently little more than schematic, and lack the life-like character of those in the earlier work of Claus. It would seem that some of the species of Cyclops described by Dana[2] are identical with the above, although details are wanting to identify positively. Without delaying to discuss the question opened as to whether these widely separated forms have all diverged from a primitive geographical center or have arisen independently from original marine prototypes, as suggested to the writer by Professor Leuckart, we may remark that the former theory is rendered possible by the fact that the feathers of water-fowl often form a vehicle for the transportation of even larger crustacea.

Amphipods, for example, are transported hundreds of miles under the feathers of geese. While it is unlikely that these larger crustaceans or their eggs would survive a long aerial journey, it is quite certain that the eggs of Cyclops would pass many hours or even days without being destroyed. On the other hand, it seems that some entomostraca are in a nascent condition which permits a slight change in the environment to induce remarkable alterations in structure which are uniform wherever this change is effected[3] and if this be not now the case with all, it may have been so at one time with the prototypes of our fresh-water copepods.

To return to the question of heterogenesis. Selecting the larger

[1] Herrick: Copepoda of Minnesota. Rep. Geol. Surv. Minn. 1881.

[2] J. D. Dana; Wilke's Exploring Exp. Crustacea.

[3] Siebold and Kölliker, Zeitschrift. 1872, p. 293. Packard; synopsis of Phyllopod crust. N. A. U. S. Geol. and Ge·g. Surv. of Col. 1873. p. 614, etc.

species of Cyclops, say *C. signatus* (= *C. coronatus* Cls.), we find a form not at all rare but less abundant than *C. tenuicornis* with which it seems to be constantly associated. In our investigations we found Signatus almost constantly larger, *in the same gathering*, than Tenuicornis. The only distinction, among those given by either Claus or Brady, which is constant is the following: in Signatus the last joint of the antennæ has a longitudinal ridge shaped like a pruning knife-blade extending beyond the end in a hook with the proximal two-thirds of its length strongly toothed. (The only other species which has teeth on the first joint is a species allied to *C. parcus* Her. found in Alabama, but this has no knife-like ridge.) The two species agree in having the ridge which extends nearly to the base of the antenna; they both have certain series of spines arranged upon definite parts of the antennæ; both have the circular series of spines on the basal joint of the fifth foot; in short there is a complete agreement even to the microscopic details—aside from the teeth above mentioned.

Nevertheless it is possible to pick out Signatus from a glass of the other form by its larger size and different color as well as to detect a different relation in proportional length of the caudal setæ, etc. Close examination fails to discover an earlier stage of Signatus while Tenuicornis is constantly accompanied by males and smaller forms as well as the larval stages. The curious fact is demonstrable that these species of the section of Cyclops with 17-jointed antennæ become sexually mature long before they are perfect in form. In this species it is no uncommon thing to see females of less than half the size of the adult with ova sacs. Indeed it is common to meet larvæ in which the antennæ are as yet composed of but few joints in a similar condition. This fact alters our conception of a species considerably, inasmuch as it has been thought sufficient to prove the maturity of a specimen to find the egg sacs developed. A glance at the literature of this family will suggest that in more than one case a species has been founded upon a larva which was simply prematurely gravid.

In *Cylops serullatus* the same fact is more easily observed, as the species is so easily recognized as to be unmistakably at an early stage. The var. Montanus Brady, is not at all a variety due to station as suggested by him but, if our observations are correct, is the last form, in exceptional cases of the common species. It is but a step further to show that as *C. tenuicornis* is a more advanced stage of the small Cyclops forms with larval characters, so *C. signatus* is but a post-imago of the former. In truth not only in this species but in all others which we have had opportunity to examine, there appear at favorable opportunities unusually large and somewhat altered forms. These large, or post-imagó stages appear to be dependent upon abundance of food and a shallow, warm habitat.

The species considered identical with *Diaptomus castor* is abun-

dant and varies in size and particularly in color. So marked are these differences that it would be difficult to believe at first sight that they are not indications of specific distinction but these changes are dependent upon food, light and other similar circumstances. The typical form is found oftenest in rather large pools with no outlet, but which do not actually dry up in summer. In length the female is often $\frac{15}{100}$ cm. sometimes less and not seldom more. In the smaller females the eggs are observed to be usually fewer, but of the same size $\frac{11}{1000}$ cm. to $\frac{1}{100}$ cm. Recently, however in a small and very shallow marsh which is frequently entirely dry, but which lies near a less shallow pool swarming with the common Diaptomus (both being half a mile distant from any other water) we found a new species of dimensions considerably exceeding those given by Brady for var. Westwoodii[1]. Closer examination showed that the size and color were the only marked differences, antennæ and first pair of feet being identical, while the fifth pair of feet were but little different and these differences were seemingly but the intensifying of the characters of the smaller species to form the larger. Here there were two pools, which within our personal recollection formed but a single body of water and were now separated but by a dozen steps, only differing as to depth and muddiness, in the one of which flourished *all stages* of the ordinary form, while in the latter the *one* enlarged form alone existed. The conclusion is almost forced upon us that the second pool needed only similar conditions to bring forth this final stage of twice the usual size (but with eggs but little larger—$\frac{11}{1000}$ cm.). Shortly afterward the more shallow pond dried up entirely so that no more of the larger form could be obtained.

It is not necessary to emphasize the fact that just such insignificant variations furnish the data upon which the generalizations of modern science must stand or fall. A most interesting field is open to any one with the opportunity to rear such forms as these under conditions which can be altered at will in order to discover what farther structural changes can be artificially induced.

The practical value of the fresh-water copepods can hardly be overstated since they are scavengers and almost entirely feeders upon animal matter. The aggregate amount of putrid flesh which the Cyclops fauna of a quart of water will consume is quite remarkable, as any one may satisfy himself by watching the decay of such a creature as a polliwog in a jar of stagnant water.—*C. L. Herrick.*

The Segmentation of the Vertebrate Head.—In a paper entitled "The segmental value of the cranial nerves," published in the Journal of Anatomy and Physiology, by A. Milnes Marshall, the author gives a clear statement as to the theory of the segmentation of the vertebrate skull, which was proposed by Gegenbaur, and is now generally accepted. While Oken, Gœthe, Owen and

[1] Op. cit. p. 60.

others taught that the skull consisted of a certain number of modified vertebræ; and Müller and others investigated the cranial nerves in the light of this theory. Gegenbaur has more recently shown that the method of these anatomists was wrong, and that the segmental nerves and visceral arches are the factors. In Mr. Marshall's own words: "While the school of morphologists we first dealt with, determined the number of the segmental nerves by that of the skull-segments, Stannius showed conclusively that there was no relation whatever between the two, but that there was a very definite and remarkable one between the segmental nerves and the visceral arches." Gegenbaur went a step further, and, starting with the segmental nerves and visceral arches, determined from them the number of head-segments, thus completely reversing the order of proceedings of the older school.

Within the last five or six years the comparative anatomy and embryology of the cranial nerves have engaged the attention of observers; the foremost among them being the late Professor Balfour and Mr. Marshall. After giving a clear summary of the evidence of the segmental value of the cranial nerves, Marshall then considers these nerves in order. The paper closes with a convenient tabular view, while the illustrations aid the learner very materially in understanding this difficult subject.

Anomaly in the Flexor Longus of the Foot.—In the dissection of a human subject, I have found a peculiar and anomalous relation of the long flexor of the foot, showing apparently an interesting case of reversion to an ancestral form. The subject was that of an adult male, and the anomaly consisted of a strong tendinous connection, about an inch in length, between the tendons of the flexor longus digitorum and flexor longus pollicis, in the region where they cross each other on the instep. This union is a permanent feature in the foot of the gorilla, where the flexor of the great toe sends on a branch, which, after uniting with the long flexor tendons of the second and fifth toes, divides into the perforatory tendons of the third and fourth toes. In the ordinary man the big toe can be flexed to a considerable extent independently, but the subject in which this peculiar arrangement was found, as in the gorilla, could not have flexed the great toe at all without an equal flexure of all the toes—*S. W. Williston, New Haven Conn., Nov. 22, 1882.*

Rotifers without Rotary Organs.—The most striking characteristic of this class of animals is the possession of rotary disks; yet it appears that species of Rotifera exist that have all other characters of the class, but are devoid of vibratile cilia. The first to notice this was Dujardin, who, in 1841, gave the name of *Lindia torulosa* to his discovery. Gosse, in 1851, described a form with similar characters. Doubt was thrown upon these observations, but Dr. Joseph Leidy has recently (Proc. Phil. Acad., 1882,

243) added to the list of non-ciliated rotifiers, and brought together the scattered information upon the subject. In the Proc. Phil. Acad., 1857, page 204, Dr. Leidy described a rotifer-like creature quite different from those before mentioned, and having a large protractile pouch or cap in lieu of the usual rotary disks. This he named *Dictyophora vorax*. Still another species was described by Mecznichow in 1866; and, another, parasitic upon worms, was observed by Claparéde in 1867. In 1882, Mr. S. A. Forbes described a form which Dr. Leidy suspects to be identical with *Dictyophora vorax*. The last discovery of Dr. Leidy is a rotifer in which a sort of head, in the form of a cup prolonged at the mouth into an incurved beak, takes the place of the rotary disk of ordinary rotifers. This creature, which is named *Aryclus inquictus* was found occupying a central position among a group of the rotifer, *Megalotrocha alba*, both parasitic upon a Plumatella from Fairmount dam, upon the Schuylkill.

The Vertebrates of the Adirondack Region.—Dr. C. Hart Merriam has published in the Transactions of the Linnæan Society of New York, the first part (Mammals) of an interesting work on the Vertebrates of the Adirondack region. The observations are fresh and authentic, the results of about twenty years exploration in winter, as well as summer, in those wilds. Few mammals, says Dr. Merriam, are commonly seen by those who traverse the forests of the Adirondacks. "This is in part due to the nature of their haunts, partly because they do not roam about much in broad daylight, but chiefly because of their shy dispositions and wary habits. The experienced hunter, more familiar with their haunts and ways, falls in with a larger number; still, by far the greater portions go unobserved. Of the forty-two kinds found here, I have myself seen living, and in the wild state, all but three; therefore the remarks upon their habits, in the following biographies are, when the contrary is not stated, drawn largely from the results of personal observation."

After discussing the geological history, topography, climate, general features, botany and faunal position of this interesting region, Dr. Merriam begins his account of the forty-two mammals of the Adirondacks, beginning with the Carnivora. In the introduction he describes a "mixed flock" observed during the fall migrations. "At this season one may hunt for hours and scarcely see a bird, when suddenly he finds himself surrounded by a host of individuals, representing many species and pertaining to widely different families." In one such flock there were at least fifty robins, all very noisy, several blue jays, large numbers of slate-colored snow birds, a few white-throated, song and fox-colored sparrows, a couple of winter wrens, and one Nashville warbler; beside these near at hand, were a dozen chickadees, with an equal number of yellow birds, and a few golden-crowned

kinglets, with several red-bellied nuthatches and a pair of brown creepers. "I have seen the purple finch in some of these mixed flocks, and a few hairy and downy woodpeckers, and hermit thrushes sometimes hang about their outskirts, but the latter are more commonly seen by themselves in groups of half a dozen or thereabouts."

The account of the panther contains considerable new matter. Dr. Merriam insists that it never climbs trees unless very young, or when pursued by dogs.

It is stated that a panther can leap an almost incredible distance. "On level ground a single spring of twenty feet is by no means uncommon, and on one occasion Mr. Sheppard measured a leap, over snow, of nearly forty feet." Important notes in its breeding habits are added. Some fallacies regarding the alleged fierceness of the panther, its mode of capturing its prey, its size and its mode of carrying its prey, are exposed, and the statement made that the panther cries and screams is called in question, those who have had to do with panthers being the most skeptical in regard to their cries. The Canada lynx, wild cat, wolf, fox, wolverine and the fur animals, and the raccoon and bear are described with many new facts or corrections of popular errors; and finally the harbor seal, which has in three instances appeared in Lake Champlain. As regards the change to a white pelage in winter of the weasel and ermine, Dr. Merriam combats the common notion that it is due to temperature, and suggests that it is due to falls of snow, the change sometimes taking place within forty-eight hours after the ground becomes covered with snow. The series, when completed, will be a fresh and valuable contribution to our knowledge of the wild animals and birds of the Eastern United States.

A CURIOUS NUDIBRANCH MOLLUSK.—A very singular animal, which lives in green ulvæ, on the shores of the Mediterranean, and which was regarded as a flat-worm by Schultze, has been lately shown by L. Graff in the Morphologisches Yahrbuch, to be really not a Turbellarian worm, but "the very lowest of all known Nudibranchs," and identical with what Kölliker long ago described as *Rhodope veranii.* It is very small, being only 4^{mm} long, with a breadth $\frac{1}{3}^{mm}$, and while closely like ordinary flat-worms, it is distinguished from them by its anus, by the structure of its generative organs, its central ganglia, and its sensory apparatus. Graff does not regard this worm-like mollusk as descended from the present specialized Dendrocœla, but from a group of Rhabdocœlida. Professor Graff does not suggest that this may be a degraded Nudibranch, which has lost its gills, buccal mass and radula, but may this not be the case? In that event it can hardly be a stem-form. This could be readily tested by a study of its embryology. The ordinary Nudibranchs seem rather to have

descended from shelled mollusks, as the embryos are provided with a temporary shell and vellum. At the same time we grant that mollusks and Turbellarian worms may have arisen from the same stem-form.

ZOOLOGICAL NOTES.—Dr. C. F. Holder is authority for the statement he makes in the *Scientific American* that a basking shark (*Cetorhinus maximus*) about seventy feet long was caught off Block island. Sir Charles Lyell records one nearly fifty-five feet long that came ashore at Rathesholm Head, at Stronsa, parts of which are now in the British museum. ——Mr. W. A. Stearns on his return from his trip to Labrador, wrote us that the polar bear had not, so far as he could ascertain, been seen this year below Rigoulet. "Year before last (1880) a walrus was killed at Fox harbor, St. Lewis sound. One of our young men secured the tusks, and has them now in his possession. The people there say that they see them frequently, but rarely get them. One was caught three years ago (1879) also at the same place."——An apparently new species of dog, supposed to have been received from the Upper Amazons, has been described in the Proceedings of the Zoölogical Society of London under the name *Canis microtis*.——Professor Flower also exhibited and remarked on the skull of a young chimpanzee from Lado, in the Soudan, which exhibited the deformity called acrocephaly, associated with the premature closure of the fronto-parietal suture.——Mr. Dobson maintains that the Dipodidæ belong with the hystricine, and not to the murine rodents.——The genus Psolus has been divided into three subgenera by Professor Bell.——M. Jourdain, of Marseilles, has recently published in the *Comptes Rendus* of the French Academy, an abstract of his studies on the finer structure of the male sexual organs and the Cuvierian organs of Holothurians, also on the histology of the digestive canal, nervous system and polar vesicles of these Echinoderms; his researches, made at the marine zoölogical laboratory of Marseilles, will be completed by studies in the circulatory apparatus of these animals.——A crinoid was obtained during the voyage of H. M. S. *Alert*, which was referred by Professor Bell to a new variety of *Antedon eschrichtii* of the arctic seas.

PHYSIOLOGY.[1]

THE RECENT ACCESSIONS TO OUR KNOWLEDGE OF THE PHYSIOLOGY OF THE HEART.—The heart in its final function is simply a pump, and it would no doubt be possible to remove this organ from the body of a living animal, and replace it by an artificial machine which should, for a time, serve very well the purposes of the heart in the circulation of the blood. As the circulation of the blood is every instant necessary to vital activity, and as, other things remaining the same, any change in the force or frequency

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

of the heart-beat must make itself felt in changing the character of the circulation, physiologists have recognized as of fundamental importance to the understanding of this subject, the clear comprehension of every physiological factor which can in any way modify the action of the heart. Of the reality of such modifying influences any one who compares his pulse rate, oberved in a standing and a sitting position, may be convinced.

The factors which must be considered as having a possible or certain influence on the rhythm and character of the heart-beat have been for several years distinctly recognized, they are: (1) the nerves connecting the heart with the brain and spinal cord; (2) the temperature of the blood supplying the heart; (3) the chemical constitution of the blood; (4) the pressure of the blood within the heart, and in the arteries outside the heart.

In 1846 Ed. Weber published the account of his brilliant researches in which he declared that when the pneumogastric nerve or the nervous centers in the *medulla oblongata*, are electrically stimulated, the pulse is slowed or the heart even brought to a complete standstill. It is now one of the settled theorems of physiology, that there is in the medulla a "cardio-inhibitory center" from which spring nerves that carry to the heart impulses which cause slowing or even stopping of its action. Some years since, Goltz showed that the cardio-inhibitory center could be excited by impulses reaching it by way of afferent nerves from various parts of the body, the excitement of the center being manifested in a slowing or stopping of the heart-beat. Many subsequent workers have shown that the cardio-inhibitory center is exceedingly susceptible to psychical or physical changes of condition in the the body; but that all modification of the heart-beat under these circumstances disappears so soon as both pneumogastric nerves are divided in the neck.

V. Bezold and his pupils more than ten years ago demonstrated that when certain nerve branches reaching the heart from the spinal cord through the last cervical and first thoracic sympathetic ganglia, are stimulated, the beat of the heart is quickened.

Until within a few months these changes of the rhythm of the heart-beat were the only ones which could be definitely shown to be brought about by nervous action. Within the last year, several physiologists, Heidenhain (Pflügers Archiv. Rd XXVII), Gaskell (Proc. Royal Soc. Dec. 8, 1881), Sewall and Donaldson (Journ. of Physiology, Vol. III, Nos. 5 and 6), working independently and by quite different methods, have shown that stimulation of the pneumogastric nerve of the frog may bring about a weakening of the heart-beat without any corresponding alteration in the rhythm of the beat. So that it is a fair conclusion that definite nerve fibers carry from the brain to the heart of the frog impulses which cause weakening of the contractions of the heart without altering their rate. These *relaxing* fibers being bound in the same nerve

bundle with the cardio-inhibitory branches, their action is, in ordinary cases of stimulation, obscured by that of the latter. All physiological analogy suggests the existence of nerve fibers of similar function in the higher animals.

Gaskell (Journ. Physiology Vol. III, Nos. 5 and 6), has gone farther than this, and shown that stimulation of the pneumogastric causes, under certain conditions, strengthening, instead of weakening, of the heart-beat without alteration of its rhythm; and in the tortoise he has actually dissected out a nerve twig, running over the surface of the heart, the stimulation of which causes simple strengthening of the heart-beat uncomplicated by any other modification.

It is, then, to-day clear that all the variations of force and frequency of action to which we know the heart-beat is subject, may be brought about by the excitement of certain nervous centers in the brain; and as nature is not in the habit of letting her powers lie idle, it is pretty certain that nervous impulses with the four distinct missions that have been indicated do, in the living body, descend from the brain to modify the action of the heart.

In the living animal the arteries are overfull, and the elastic arterial wall straining upon the blood inclosed by it, forces the fluid with a definite pressure onward on its path of circulation. It is this pressure of the blood in the aorta which the heart must overcome in emptying its ventricles; and it is a question of fundamental physiological importance whether in the mammal variations in arterial pressure, that is the resistance which the heart has to overcome, cause corresponding variations in the pulse rate. This problem, whose solution is apparently so simple, has been answered in every possible way by different and equally competent experimenters. With the heart in the body, and in physiological connection with the vascular apparatus, the conditions of experimentation are hopelessly complicated.

A little more than a year ago, Professor Martin at Baltimore (Studies Biol. Lab. Johns Hopkins Univ. Vol. II, No. I), hit upon an ingenious and simple method of isolating completely the living mammalian heart from the rest of the body. Martin's method consists, essentially, in opening the chest of a completely narcotized dog; all the arteries arising near the heart are tied, except two; one of these is connected with a mercury manometer, by means of which the amount of blood pressure and the pulse rate are recorded; the other open artery has inserted in it a tube through which blood may flow from the heart. All the great veins entering the heart are tied, except one, and into this is allowed to flow warm defibrinated blood from a flask. When the proper temperature and artificial respiration are maintained, the heart may continue to beat normally for hours. On the heart thus severed from its physiological connection with every other organ, a most important and interesting series of studies has been made by Professor

Martin and his pupils (Stud. Biol. Lab. J. H. Univ. Vol. II, No. 2, Trans. Med. Chirurg. Fact. Md. 1882). It has been found that variations of enormous extent of either arterial pressure, the resistance to the outflow of blood from the heart, or of venous pressure, that under which blood enters the heart, have no effect whatever upon the pulse rate. The work has furthermore suggested to its author some simple explanations of the causes of the conflicting results of previous experimenters. But Martin has found, as was to be expected, that, though the pulse rate is unaltered by great changes in the mechanical conditions under which the heart acts, the organ is extremely susceptible to changes of temperature, and beats uniformly quicker or slower as the temperature of the blood entering it rises or falls the fraction of a degree. The application of this new method of studying the mammalian heart opens the way for a series of researches that promises rich results for physiology.

In connection with this subject, the recent work of Ludwig and Luchsinger is of considerable interest (Pflüger's Archiv. Bd. xxv). These authors showed that the inhibitory power which the pneumogastric nerve when stimulated, exercises over the heart-beat of the frog, is diminished or altogether overcome by increasing intracardiac pressure. Later, Sewall and Donaldson taking up the same line of work (*loc cit.*), have found that it is only the fluid pressure within the venous chambers of the heart which has an effect in modifying the power of pneumogastric inhibition; thus showing that changes in the hydrostatic conditions under which the heart works may affect the action of that organ indirectly, through increasing or decreasing the efficiency of controlling influences reaching it along certain nervous paths; though such changes of fluid pressure may in no wise alter the rhythm of the pulse when the heart is kept strictly to itself.

If the results which have come out of the study of the physiology of the heart during the last year or two, are to stand, we shall be led to conclusions that make a new chapter in physiology.

We must look upon the heart as an automatic organ whose action has a definite rhythm, which is to an extraordinary extent unaffected by changes of condition operating directly upon the organ itself. But the heart is in nervous connection with various centers of the brain, which, it is fair to assume, are extremely sensitive to all those changes of condition in the body to which the heart, by an altered rhythm or force of beat, must coördinate its action. To use a figure of speech, the nervous master in the brain is the first to perceive the needs, as to the circulation, in the whole or any part of the body, and is most alert to answer them; while the muscular servant, the heart, has enough to do to carry on its work of prime importance, and is blind and deaf to nearly all occurrences except those messages that reach it from headquarters.

THE POISON OF THE SCORPION.—The poison and poisoning-apparatus of the scorpion have been recently made an object of study by M. Joyeux-Laffuie. The former, he finds, is very active, though not so powerful as some have represented. A drop of it, either pure or mixed with a little distilled water, rapidly kills a rabbit, when injected into the cellular tissue. Birds are as easily killed with it as mammals. One drop suffices to kill seven or eight frogs. Fishes, and, above all, mollusks, are much more refractory. But, on the other hand, the articulata are wonderfully susceptible; the hundredth part of a drop will immediately kill a large crab. Flies, spiders and insects on which the scorpion feeds, are quickly affected by its sting. The poison soon paralyzes the striated muscles, suppressing spontaneous and reflex movements. In all animals there is first excitation, then paralysis. The author regards the scorpion's venom as a poison of the nervous system, not a poison of the blood, as M. Joussel de Bellesme asserts.

ELECTRIC ORGANS OF GYMNOTUS.—In the appendices to Sachs and Du Bois Reymond's work on the electric eel, G. Fritsch gives an account of his histological and morphological investigations on the nervous and electric apparatus. He finds, says the Journal of the Royal Microscopical Society, support for the doctrine that the electric organs of Gymnotus have been developed from transversely striated muscle; a portion, the lowest lateral muscles, having been separated from the rest to form the so-called intermediate muscular layer, while a superior mass of muscle was converted into the great electric organ.

SENSE OF SMELL IN ACTINIÆ.—It has been discovered by Mr. W. H. Pollock and Dr. G. J. Romanes, that the common sea-anemone is conscious of the presence of any kind of food (pieces of cockle, mussel, &c.), placed near them. If the food was held within a span's breadth of an anemone it opened; if it was held in the centre of a circle of anemones they gradually opened in succession. They were found, however, to be unable to localize the direction in which the food was lying. Dr. Romanes considers that the sense which is thus shown to be possessed by these animals may most properly be called a sense of smell, and they are the lowest animals in which any such sense has hitherto been noticed.—*Journal of the Royal Microscopical Society.*

SALINE ELEMENTS IN THE BLOOD OF MARINE CRUSTACEA.—It has been observed by M. Fredericq (Bull. Belg. Acad.) that the blood of crabs and other Crustaceans at Ostend has the same strong and bitter taste as the sea water, and proves to have the same saline constitution. Crabs in brackish water, on the other hand, have a less salt blood, and the crayfish of rivers have very little of soluble salts in their blood. An exchange of salts seems to take place in these animals between the blood and the outer medium, producing approximate equilibrium of chemical composition. This

probably occurs through the respiratory organ, and is according to the simple laws of diffusion. On the other hand, the blood of sea-fishes, has an entirely different saline composition from that of the water; it is more or less isolated, presenting herein an evident superiority over the invertebrates referred to.—*Nature.*

PSYCHOLOGY.

ANECDOTE ABOUT CATS.—Incidents showing some power of reason are often related of animals, especially those domesticated; but I do not think the following have ever appeared in print: Near Vineland, N. J., some boys discovered a woodchuck's burrow *(Arctomys monax* L.), containing both adults and four young. The father and two of the young were killed; the mother and the other two young were taken home, and imprisoned. During the night the mother made her escape. As a matter of experiment, the young were placed with a cat, at that time suckling her two kittens. Shortly after the cat came into the house somewhat uneasy. One of the boys went out with her to the novel family, and finally succeeded in pacifying her to such an extent that she allowed the strangers to suckle. But now a new difficulty arose. There were but two teats sufficiently developed to afford nourishment. A struggle ensued as to who should obtain possession. The woodchucks being the stronger, came off victorious. The kittens showed their dislike to this arrangement by scratching and pushing, and as it was evident that two of the four must be removed, a decision was given in favor of the woodchucks. Shortly after, one of them died; whether the other ever reached maturity or not, I do not know, but understood that it continued to suck the cat for some time. That cats are not always so accommodating as the above individual, I know from the fact, that once when I endeavored to have a cat with three kittens assume charge of two more, I was obliged to hastily withdraw them to prevent their being killed. In another case one kitten was nourished by two cats. As to whether either was the parent or not, I cannot say. Once when the mothers desired to remove their child from the mill where it was then located, to a neighboring house, they found their infant, corpulent with the abundant nourishment, too heavy for either alone, and consequently were obliged to carry it between them.—*Henry Turner.*

THE MODIFIED INSTINCTS OF A BLIND CAT.—Mr. H. C. Hovey contributes to the *Scientific American* the following interesting article on the modified instincts of a blind cat. The family favorite, whose misfortunes have afforded an opportunity to observe the workings of instinct under difficulties, is a noble specimen of the genus Felis. "Dido" is his name—given for simple euphony, without regard to gender. During the four years of his life he has never been known to do anything wrong, unless it be to fight

most desperately against all feline intruders. In some one of his many encounters, Dido met with an injury to one of his feet that made a surgical operation necessary, from which he recovered, but shortly afterward went totally blind. A cataract was formed over each eye, by which, as repeated experiments proved, vision was thoroughly obscured.

This calamity came on suddenly, and placed the cat in circumstances not provided for by the ordinary gifts of instinct. What to do with himself was plainly a problem hard to be solved. He would sit and mew most piteously, as if bemoaning his condition; and when he attempted to move about, he met with all the mishaps that the reader will be likely to imagine. He ran against walls, fell down stairs, stumbled over sticks, and when once on the top rail of the fence, he would traverse its entire length seeking in vain for a safe jumping off place. On being called, he would run about bewildered, as if not knowing whence the voice came nor whither he should go to find the one calling. In short, Dido's life seemed hardly worth living, and we were seriously plotting his death, when the cat himself clearly concluded that he must make his other senses atone for the loss of sight.

It was very curious to watch his experiments. One of the first of these was concerning the art of going down stairs. Instead of pawing the air, as he had been doing on reaching the top step, he went to one side till he felt the banisters touch his whiskers, and then, guided thus, he would descend safely and at full speed, turning into the hall on gaining the last step. One by one he made each familiar path a study, determined the exact location of each door, explored anew all his old haunts, and seemed bravely resolved to begin life over again. The result was so unexpectedly successful that we were deceived into the notion that sight had been restored. But by placing any obstacle in the path, and then calling him eagerly to his customary feeding place, it was evident that he was entirely blind, for he would run with full force against the box or other obstruction, and then, for some time afterward, he would proceed with renewed caution.

Dido's "voice is still for war," and his blindness does not make him any less successful in his duels with intruders. He even goes abroad in quest of adventures, and comes safely home again.

His value as a mouser does not seem to be in the least diminished. One of my experiments as to his capacity in this direction came near costing me dear. I had heard the gnawing of a rat in an old closet where there lay a quantity of newspapers. Here it was decided to leave Dido over night, and while arranging the papers for that purpose, my hand was suddenly caught by the claws and teeth of what at the moment seemed like a small tiger. Poor Dido! He really looked ashamed of his blunder in mistaking my hand for his anticipated victim. Fortunately the papers served as a shield, or the injury inflicted might have been more

serious. I may add that, on opening the closet next morning, there was Dido mounting guard over a slain rat as big as ever spoiled good provisions or tried a housekeeper's temper.

It is well known that the house-cat will find its way back from distant places to which it has been carried blindfolded; and how it performs such feats naturalists have never satisfactorily explained. The theory accepted by some of them is that the animal takes note of the successive odors encountered on the way, that these leave as distinct a series of images as those we should receive by the sense of sight, and that, by taking them in the inverse order from that in which they were received, he traces his homeward route.

But, in the cat now described, the sense of smell is by no means acute, as has been proved by a variety of methods; and moreover, although, as one might say, perpetually blindfolded, he quite uniformly chooses the shortest road home without reference to the path he may have taken on leaving the house. Curious to see how far this homing instinct would extend, I took advantage of a fall of snow that wrapped under its mantle every familiar object, concealed all the paths, and deadened every odor and sound. Taking Dido to a considerable distance from the house, and making a number of turns to bewilder him, I tossed him upon a drift and quietly awaited results. The poor creature turned his sightless orbs this way and that, and mewed piteously for help. Finding, at length, that he was thrown entirely on his own resources, he stood motionless for about one minute, and then, to my amazement, made his way directly through the untrodden snow to the house door—which, it is needless to add, was promptly opened for the shivering martyr to scientific investigation, to whom consolation was forthwith offered in a brimming bowl of new milk.

My conclusion, therefore, is that Wallace's ingenious theory of accounting for orientation by what he calls "brain registration," will not explain what has been described; but that the mysterious homing faculty is probably independent of such methods of gaining knowledge as have been ordinarily observed, and is analogous to the migratory instinct controlling the long flights of some species of birds.

Additional remarks relative to teaching Brutes the use of Letters.—In the article published in the January number of the Naturalist, I endeavored to indicate very briefly the method to be pursued in a suggested investigation into the limitations of the mental action of brutes. From some comments upon the article I have been led to believe that it would be acceptable to some of your readers to add a brief supplement relating to further details.

If dogs were the subjects chosen for experiments as suggested—

they being best adapted to the purpose from several points of view—a number of both sexes would be secured; the most intelligent individuals of the most intelligent species being selected; probably that known as "French poodle." They would be taught in classes in order to profit by ambition and example; and a judicious system of rewards and punishments adopted. The intelligent and healthy would be mated; the stupid or weakly would be discarded.

In each generation the standard of ability being raised as the circumstances justified, the law of adaptation would be brought to bear in conjunction with artificial selection.

Then the laws of heredity would be so followed as to render probable the production of exceptional individuals in the direction desired; thus profiting by the tendency to radical variation to secure a new variety of exceptional capabilities.

Is it not possible that inquiries into the operation of the lower orders of mind may suggest improvements in the training of the higher grades?—*Wm. B. Cooper.*

[NOTE BY THE EDITORS.—A valuable article on this subject appeared in the number of the London *Journal of Science*, corresponding to the number of the NATURALIST in which Mr. Cooper's article was published, viz. Jan. 1883. Mr. Cooper's present note expresses recommendations contained in the *Journal of Science* article, which, however, prefers parrots to dogs as the best animals for experiment.]

ANTHROPOLOGY.[1]

ETHNOLOGY OF THE VEGA.—All the world has read the story of the *Vega*, how the brave Nordenskjöld in the steamer *Vega*, setting sail from Tromsö, in Northern Norway, on the 21st July, 1878, explored the entire arctic coast of Europe and Asia, wintered for ten months in Kolyutschin bay, and returned by Behring strait and the Suez canal to the point of departure. It is not our province to dwell upon the brilliancy or the value to commerce and material science of this first circumnavigation of Europe and Asia. In the course of his journey Nordenskjöld was brought into close relationship with the inhabitants of the high north, and it is with this portion of his work that we have to do.

Samoyeds (Mongoloid division, Ural-Altaic stem, Samoyed branch. *Peschel*).—Of these people Nordenskjöld says: "The Samoyeds, living neighbors to several Finnish-Ugrian races (Lapps, Syrjæni, Ostjacks and Voguls) are believed by some writers to be closely allied to the Fins and Finnish races in general. The comparison of the languages, however, shows a very wide divergence, and the anatomical characters have not been sufficiently scrutinized." These people were met with along the

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

coast of Northeastern Asia, from the southern extremity of Nova Zembla to the mouth of the Ob-Irtisch river, principally throughout the Yalmal or Samoyed peninsula. The relations of this branch to their neighbors and to their environment are described, as well as their dress and dwellings, their customs and modes of burial, their status in culture compared with that of other boreal races, and their place in ethnography assigned (pp. 60-83).

The Chukches.—In the whole stretch from Yugor Schar, south of Nova Zembla to Cape Chilagskoi the *Vega* party saw neither men nor human habitations. At the latter place (172° E.) they came suddenly upon the Chukches. "Every man, with the exception of the cook, rushed on deck. Their boats were of skin built in the same way as the 'umiaks,' or women's boats of the Eskimo." From this point to Konyam bay, south of Behring strait, they were constantly in the company of this race. On the 28th September the *Vega* was caught in the ice at the mouth of the Kolyutschin bay, and remained there until the 18th July following, when, decked with flags, she sailed again on the way to her destination. In this long and lonesome winter they had most abundant opportunities of getting acquainted with this race. The Chukches are divided sharply by their domestic animals into Dog-Chukches and Reindeer-Chukches. In point of rank in culture they stand between the Samoyeds and the Eskimo. Lieut. Nordquist drew up an extensive vocabulary of the language and a sketch of the grammar, but they are only briefly mentioned in the preliminary volume. So far as observed there seemed to be very little social organization beyond the family, no religious ceremony beside the customs in the presence of death, and no ownership excepting the personal property in dogs and reindeers and whatever else is connected with the house and the chase. In the minutest manner Professor Nordenskjöld describes their dress, houses, furniture, boats, sledges, ivory ornaments, fishing and hunting, hospitality, begging, trading, customs of marriage and burial; in fine, he has given us an exceedingly useful monograph of the people. The professor was not unmindful that he was in the presence of a civilization in many respects similar to that which once occupied the valley of the Dordogne, and improved his opportunities by observing those occupations which would explain some of the enigmas in the caves of France. The work is profusely illustrated with sketches of Chukch life and with drawings of their culture-objects.

Leaving the land of the Hyperboreans, the company of the *Vega* had a pleasant voyage home, making their stay at Japan, Borneo, Suez and other points sufficiently long to receive the merited applause of the people and to record some very interesting facts concerning the manners and customs of the localities.

Professor Nordenskjöld is at great pains to narrate the various attempts that have been made to explore the regions through

which he passed. The title of his preliminary volume is as follows: "The Voyage of the *Vega* round Asia and Europe, with a historical review of previous journeys along the north coast of the old world," by A. E. Nordenskjöld. Translated by Alexander Leslie, with five steel portraits, numerous maps and illustrations. New York, Macmillan & Co., 1882, pp. XXVI, 756, 8vo.

The Manuscript Troano.—Professor Cyrus Thomas has sent us the advanced sheets of a work bearing the following title: "A study of the Manuscript Troano," by Cyrus Thomas, Ph.D., with an introduction by D. G. Brinton, M.D. [From contributions to North American ethnology, Vol. VI.] Washington, Government Printing Office, 1882, pp. 233, 4to, with 100 figures and XXXIV plates.

Dr. Brinton's introduction relates to graphic methods in general and the ancient Maya records in particular. He introduces Dr. Friedrich Müller's neat distinction of thought-writing and sound-writing. We have an ascending scale of pictures, pictographs, hieroglyphics, syllabic signs aad alphabets proper. The Indians of the U. S. had only pictures; the Aztecs, picture-writing and, quite certainly, a true phonetic system; the Mayas had a hieroglyphic system known only to the priests and a few nobles, containing pictures, diagrams and phonetic signs. Dr. Brinton gives very useful sketches of the Dresden Codex, the Codex Pereseanus and the Codex Troano, and concludes his essay by a short history of the various efforts at interpretation.

Professor Thomas, after a preface, apologetic and historical, proceeds to elaborate with great minuteness what has been given to the readers of the Naturalist and the members of the American Association in outline. As it is the purpose of this notice merely to call attention and not to criticise, the contents of the volume are given below:

It will be admitted by all who read this work that Dr. Thomas has made a solid contribution to knowledge.

ARCHÆOLOGICAL LECTURES.—Glancing over the Boston *Evening Transcript* for November 25th, our eyes were attracted to a column headed "Archæological Explorations in Ohio." If one should read on he would discover that: "The third lecture of the course complimentary to the subscribers to the exploring fund of the Peabody Museum, expended during the past summer, was given on Thursday last at the museum, by the curator, F. W. Putnam. The ancient cemetery, with its singular ash pits near Madisonville, Ohio, formed the subject of the lecture.

"The next lecture will be given on Thursday afternoon, Dec. 14, instead of Dec. 7, as formerly announced, and will be upon 'Fort Ancient,' which is the largest earthwork in the United States.

"These lectures are free to all interested, but cards of admission must be applied for."

Nothing would give the editor of this department more pleasure than to play Captain Cuttle for all the *archæologists, anthropo-biologists, comparative-psychologists, glossologists, ethnologists, technologists, sociologists* and *comparative-mythologists* of our country, in order to put intelligent students of anthropology on the track of the good things that are being accomplished and the good words that are being spoken with reference to the natural history of man.

OF THE MUSIC OF NORTH AMERICAN INDIANS we possess only an imperfect and scattering knowledge, for among the authors on the subject a small minority only could boast of any acquirements in theoretical music. Now a recent writer, Theodore Baker, has in 1880 examined personally the songs and tunes of several of our Indian tribes, and has brought to bear on these a fair knowledge of musical theory, obtaining thereby many curious results. From forty-two songs and tunes, obtained from representatives of at least twelve tribes, and appended to his publication: "Ueber die Musik der nordamerikanischen Wilden," Leipzig, 1882, 8vo, pp. 82, illustr., he feels justified to refute the common idea that Indian melodies cannot be expressed by our musical scales and notes (p. 22 *sq.*). A large majority of their tunes show a purely diatonic progress in their notes, and the gamuts or scales, in which they move, are comparatively few in number. The majority of the melodies examined seem to belong to the Lydian scale (c d e f g a h c′) and to the Hypophrygian (g a h c′ d′ e′ f′ g′),[1] but in very few of them will be found *all* the seven notes of the diatonic scale. Every melody has the quint or fifth with its key note; one-half of them have the major third or diatone, while the flat or minor third occurs in a few only; the fourth and the sixth frequently occur, but the seventh note is rather scarce. Although the Indian uses all the

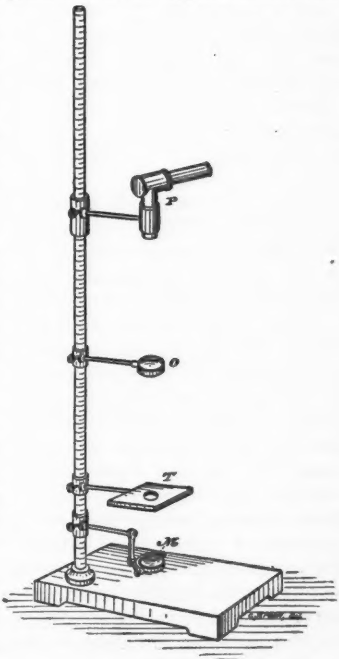
[1] Equivalent to our c sharp and g sharp gamut-scale.

seven notes of our musical scales, he avoids many of our melodial sequences ; the majority of his tunes follow the *dur* or *sharp* scales and the two-eighth or two-fourth measure. The instruments accompanying Indian song are the flageolet, flute, panflute, whistle, and various kinds of tambourins, drums and kettledrums. See Baker, Theodor: Ueber die Musik der nordamerikanischen Wilden, Leipzig, Verlag von Breitkopf und Härtel (Haertel), 1882, 8vo, pp. 82, 2 plates, of which one is colored.—*Albert S. Gatschet.*

MICROSCOPY.[1]

Drawing Apparatus of Professor His.—In part first of his "Anatomie menschlicher Embryonen," pp. 8–9, Professor His has described a drawing apparatus altogether similar to the one here represented.

For anatomical and embryological work, an apparatus of this kind is simply indispensable. As every working naturalist knows, an apparatus that admits the use of the *camera lucida* with a low magnifying power, varying from five to forty diameters, offers many advantages that are not to be obtained from any system of microscopical objectives. In the absence of such an instrument, one is compelled to draw by measurement and "by the eye," a process which at best is slow and tedious, and liable to many inaccuracies. The foundation of every thorough embryological work consists, as Professor His remarks, *of exact drawings of the entire embryos as well as the sections obtained from them.* Any one acquainted with the embryometrical investigations of Professor His on the chick, will hardly require to be told that such surface views as he employed for orientation in microtomic sections, could not be obtained without the aid of photography, or the camera lucida, or by both. The instrument here described offers the same facilities for obtaining



His' Drawing Apparatus.

[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

the exact topographical relations of a complicated object with low magnifying powers that the microscope affords with higher powers. Further, only a single plano-convex lens 2.5^{cm} in diameter, is required for an enlargement varying at pleasure from five to fifty diameters. Professor His employs as an objective a stereoscope-head (of Dallmeyer), or a small Steinheil aplanat (No. 1).

The instrument consists of a heavy circular iron base,[1] from the center of which rises a brass rod, marked to centimeters, half centimeters, and millimeters. On this rod are seen the mirror (*M*), the object-table (*T*), the objective (*O*), and the camera lucida (*P*), all supported by horizontal bars that move on sliding ferrules, The mirror is placed as near the base as convenience will allow, and its supporting bar is 7.5^{cm} long. The bars bearing the other pieces are all of corresponding length, and the sliding ferrules can be fixed at any point by the aid of set-screws. The ferrules of the mirror and the object-table are made of such length that when in contact with each other and resting on the highest part of the base, they are in the position required for the lowest magnifying power. In this position the object-table has an elevation of 11^{cm}, the objective 18.5^{cm}, and the camera 22^{cm} above the lower face of the base, or what may be called the drawing plane.

Thus placed the focal distance is 7.5^{cm}, and the camera is considerably lower than it is possible to have it in ordinary microscopes. The magnifying power is 10 diam., but it may be reduced to 5 diam. by elevating the drawing plane. It is of course possible to obtain a lens that will magnify only 4 or 5 diam. in the normal position of the drawing plane, and endeavors will be made to provide the instrument with such a lens.

The magnifying power may be increased in several ways, but most conveniently by shortening the focal distance and raising the camera until it is properly adjusted. Starting with the parts placed as above given, in order to raise the magnifying power from 10 to 15 diam., the objective must be lowered 7^{mm} and the camera elevated 2^{cm}; and for 20 diam., the objective must be lowered 10^{mm} and the camera elevated 3.5^{cm}. Keeping the object-table in its first or normal position, the magnifying power may be increased to 50 diam. by lowering the objective 2^{cm} and raising the camera 15^{cm}. The camera thus has an elevation of 37^{cm} above the normal drawing plane. The magnifying power may also be increased by lowering the drawing plane, or what is the same thing, by raising the object-table.

The positions which the objective and camera must have for a given magnifying power will probably vary slightly in two instruments made as nearly alike as possible, but their determination is a very simple matter; and having been once accurately ascer-

[1] This form has been found more convenient than the rectangular form seen in the figure.

tained, they may be tabulated and kept for subsequent use. To ascertain these positions for any given magnification, a millimeter scale may be placed on the object-table, and the camera and objective moved until the picture projected on the drawing plane has the desired enlargement. When the scale is replaced by the object, care must be taken to have the surface, which is to be outlined, in the plane previously occupied by the scale. To this end it may be necessary to move the object-table a very little, in order to give a sharply defined picture, the positions of the camera and objective being left unaltered.

The object-table measures 8×10^{cm}, and has a central perforation 2.5^{cm} in diam. The whole apparatus is completed by a movable shade, designed to cut off the light falling on the lens and on the drawing plane.

It is hardly necessary to remark that opaque objects require direct sunlight or light from a lamp supplied with a bull's eye condenser.

This instrument, including lens, and Oberhäuser's camera lucida, may be obtained from Geo. A. Smith & Co., 7 Park street, Boston, for thirty dollars. For everything except the camera, the price is fifteen dollars.

THE MICROBE OF "RED EVIL," A PIG DISEASE.—A disease of pigs, known in France as *rouget* or *mal rouge* (red evil), has of late, says the *English Mechanic*, wrought terrible ravages in the Rhone valley, 20,000 pigs having succumbed in a year. M. Pasteur has detected the microbe to which the disease is due. It is something like that of chicken cholera, but much smaller and different in physiological properties. Its form is that of the figure 8. It has no action on fowls, but rapidly kills rabbits and sheep. Injected in almost inappreciable quantity into pigs, it suffices to cause mortal disease. M. Pasteur has succeeded in producing an attenuated form of this virus, wherewith healthy pigs may be vaccinated and rendered refractory to the contagion.

——:o:——

SCIENTIFIC NEWS.

— Dr. D. G. Brinton, of Philadelphia, is about to publish an important work entitled LIBRARY OF ABORIGINAL AMERICAN LITERATURE. The following are some of the works which it is proposed to issue in this series: No. 1. THE CHRONICLES OF THE MAYAS, edited by D. G. Brinton, M.D. This volume will contain five brief chronicles in the Maya language of Yucatan, written shortly after the conquest, and carrying the history of that people back many centuries. Four of these have never been published, nor even translated into any European tongue. Each will be given in the original, with a literal translation and grammatical and historical notes. To these will be added a history of the

conquest, written in his native tongue by a Maya chief, in 1562. This also is from an unpublished MSS. The texts will be preceded by an introduction on the history of the Mayas; their language, calendar, numeral system, etc., and a vocabulary will be added at the close. No. II. CENTRAL AMERICAN CALENDARS. A number of native calendars and "wheels," used by the Mayas, Kiches, Cakchiquels, and neighboring tribes, in reckoning time and forecasting the future, will be published for the first time, with explanations. From lack of sufficient material, this important point in American archæology has remained extremely obscure. The collection which it is intended to embrace in this volume is unquestionably unique of its kind. No. III. THE ANNALS OF QUAUHTITLAN. The original Aztec text, with a new translation. This is also known as the *Codex Chimalpopoca.* It is one of the most curious and valuable documents in Mexican archæology. No. IV. THE NATIONAL LEGEND OF THE CREEKS, edited by Albert S. Gatschet. Mr. Gatschet will present (1.) The original German account, written in 1735, by which this legend has been transmitted; (2.) Its English translation; (3.) Its retranslation into the Creek language, in which it was originally delivered, by an educated native; (4.) Its translation in the Hitchiti, a dialect cognate to the Creek; (5.) Glossaries and ethnographic notes. No. V. THE CHRONICLES OF THE CAKCHIQUELS. These chronicles are the celebrated *Memorial de Tecpan Atitlan* so often quoted by the late Abbe Brasseur de Bourbourg. They are invaluable for the ancient history and mythology of Guatemalan nations, and are of undoubted authenticity and antiquity. Each of these works will be printed in the original tongue, with an English translation and notes. Every work admitted to the series will be the production of a native, and each will have some intrinsic importance, either historical or ethnological, in addition to its value as a linguistic monument. Most of them will be from unpublished manuscripts, and every effort will be made to secure purity of text and competent editorship. A subscription to the first number will not bind the subscriber to future volumes. The address of the publisher is D. G. Brinton, M.D., 115 South Seventh street, Philadelphia.

— Belgian Prize Essays.—From the Belgian Academy comes an offer of 3000f. for the best essay on the destruction of fishes by the pollution of rivers. Four topics, says *Nature*, are specified: 1. What are the matters special to the principal industries which, mixing with the waters of small rivers, render them incompatible with the existence of fishes, unfit for public supply and hurtful to cattle? 2. A list of the rivers of Belgium which are now "depopulated" by reason of impurities produced by factories, with an enumeration also of the fishes useful for food found in the various streams before industrial institutions had sent waste products into the waters. 3. Investigation and indication of

practical means regarding the purification of the waters as they came from the works so as to render the streams suitable for fish life without crippling the industry, and taking into consideration such resources as may be offered by the construction of basins for deposition, of filtration apparatus, and of the recourse to chemical reagents. 4. Separate experiments on the matters which, in each special industry, cause the death of fishes, and on the degree of the resistance of each edible fish to destruction. All the memoirs must be sent in before October 1, 1884, to receive any attention.

— The general regret and sense of the great loss to biological science in the death of Professor Balfour, has led to the establishment of a memorial fund, the proceeds of which are to go to establish a studentship of $1000 annually, to be open to any one, in any country, for original research in animal morphology. A committee has been constituted in this country of which Professor H. Newell Martin of Johns Hopkins University, Baltimore, Md., is the secretary. It is hoped that contributions, even if in small sums, will be sent by biologists in this country, so as to give an international support to the movement. The student appointed to fill the place must reside at Cambridge, England, but will be entitled to grants for aid in research, or in traveling or exploring with a view to furthering the science.

— A private letter received in Detroit announces the death of the Rev. Titus Coan, at Hilo, Sandwich islands, December 2, aged 82 years. Dr. Coan was a veteran missionary of the American Board, and had been known for years as the apostle of the Sandwich islands, having been there for over fifty years. For nearly forty years he has contributed able accounts to the *American Journal of Science*, of the eruptions of Mount Loa and Kilauea.

— The Buffalo Society of Sciences has had a bequest from Dr. Hayes, said to amount to $150,000, which however will not be available at present. The society has just completed arrangements for printing its Bulletin for a year or more in advance.

— The first of a series of free lectures under the auspices of the New York Academy of Sciences was given in the new hall of the Academy of Medicine, by Professor Edward D. Cope, of Philadelphia, on "The Evolution of the Vertebrata."

— By the will of the late Augustus Story $10,000 is left to the Essex Institute, Salem, Mass., the income to be given to his sister Eliza during her life.

— Some forty eminent Germans have founded, says *Nature*, a German Botanical Society.

—Died on the 24th of November, Mr. Andrew Pritchard, author of "A History of Infusoria," the fourth edition of which

was published in 1861, numbering nearly 1000 pages. He was also the author of "Microscopic Illustrations," "Micrographia" and the "Microscopic Cabinet," but he will be chiefly held in remembrance in this country as the author of the useful and laborious work first mentioned. He was born in London in 1804.

— Casimir-Joseph Davaine, who first suggested, says the *Journal de Micrographie*, the germ disease theory, and who discovered the bacterium of carbuncle, died at Garches, near Paris, Oct. 15, 1882.

— Dr. Thwaites, for many years director of the Royal Botanic Gardens, Peradeniya, Ceylon, died, Sept. 11, at Kandy.

——:o:——

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Dec. 8.—Communications were presented by Professor Theo. Gill on the Stromateidæ; Professor D. W. Prentiss on changes produced in the bird fauna of the District of Columbia by modifications of its topography.

Dec. 22.—Communications were made by Dr. Elliott Coues on zoölogical nomenclature applied to histology; Dr. M. G. Ellzey on hybrid sterility; Dr. T. H. Bean on the occurrence of the alewife in Lake Ontario; and by Professor C. V. Riley on the lignified snake of Brazil, with exhibition of specimen.

New York Academy of Sciences, Dec. 18.—A paper was read on the language, beliefs and superstitions of the Iroquois Indians (illustrated with early and remarkable manuscripts dictionaries, etc., etc.), by Mrs. Erminnie A. Smith.

Boston Society of Natural History, Dec. 20.—Miss Alice A. Fletcher gave an account of the sun dance of the Sioux Indians; and Dr. Charles S. Minot spoke on the rate of growth in man.

Jan. 3, 1883.—Professor C. O. Whitman described a rare form of the blastoderm of the chick, and discussed its bearing on the question of the formation of the vertebrate embryo; Dr. S. Kneeland presented some notes on the natural history of the Philippines, etc., showing specimens.

American Geographical Society, Dec. 20. — Andrew D. White, LL.D., delivered a lecture on the New Germany.

Jan. 9, 1883.—Daniel C. Gilman, LL.D., delivered the annual address, entitled the North American continent, four centuries of discovery.

Appalachian Mountain Club, Dec. 15.—Mr. W. O. Crosby read a paper on the mountains of Eastern Cuba.

Chicago Biological Society, Oct. 2, 1882.—Dr. H. Valin read a paper on experiments in artificial production of organic forms.[1] In January of the present year the French chemists, D. Monnier and C. Vogt, presented, through M. Robin, to the French Academy of Sciences, the results of some experiments showing that the forms peculiar to plants and animals also appear under certain circumstances in purely inorganic things (*Comptes Rendus*, Jan. 2, 1882). This is their language: "Objects endowed with well-defined shapes, exhibiting all the characteristics of the forms met in organic bodies, such as simple cells, cells with porous tubes attached, tubes with walls or with partitions, filled with hetereogeneous and granular contents, etc., can be artificially produced in an appropriate liquid by the reactions of two salts, forming, by double decomposition, either two, or one insoluble salt. One of the salts must be dissolved in the liquid, while the other must be solid in form. * * * * The forms met in organic bodies (cells and tubes) being produced just as well in a liquid with an organic or semi-organic (sucrate of calcium) origin as in a liquid of a purely inorganic origin (silicate of sodium), there cannot be henceforth any characteristic forms by which to distinguish inorganic bodies on the one hand, from organic bodies on the other. * * * * It is likely that the inorganic substances met in organic protoplasm have some function in determining the forms which living organisms assume."

Dr. Valin had repeated these experiments a number of times in the last six months, and made the following observations: In a flask full of soluble glass, were placed fragments of sulphate of iron, ten grains in weight, which immediately began to assume a colloid condition on the outside, and shot tubular prolongations, colloidal and cellular, which grew at the rate of half an inch in twenty-four hours. Some attained to two inches in length, and were about $\frac{1}{12}$ of an inch in diameter. All these prolongations shot a number of slender filaments from various points of their surface, and these attained a length of a few inches in a few hours. After a few days or weeks all these organisms assume a crystalline condition and become empty inside. Some of them rise to the surface of the liquid. They are insoluble in water, they remain intact when exposed to air, and when introduced in a newly prepared flask at the same time with fresh fragments, they hasten the metamorphosis of these. The addition of water to the soluble glass renders the experiments more easy and saves time.

Watched under the microscope, the fragments of sulphate of iron are seen to swell all around. An unctuous, colloid mass is formed, which consists of fine granules perfectly similar to animal tissues. This mass stretches into prolongations, and fluid contents are seen to flow inside these. When the surface of some prolongations was opened into, a semi-solid substance grew out

[1] See American Naturalist, 1882, p. 509, "On the Nature of Life."

of the opening into new prolongations. One of these mineral organisms, when placed on a fresh fragment, shot some new prolongations, as if real grafting had taken place.

Organisms of sulphate of copper, sulphate of zinc, alum, phosphate of iron, etc., were similarly obtained, each possessing a form peculiar to itself and distinct from the others. Analogous forms grew in saccharated lime-water. Cellular bodies of the same minerals formed in solutions of alkaline carbonates.

These experiments relate to the almost unknown department of chemistry which treats of colloids, and as crystalline solutions grow into symmetrical crystals, so a colloid substance in process of formation assumes a typical form, and must be the start of all forms in animals and plants. These so-called mineral organisms, viewed with the naked eye, under the microscope, or chemically tested, come as near to the lower animals and plants, as these are from one another, and form a new field of investigation for the biologist. We can no longer say that only living things grow, unless we reckon these as living.

Among the conclusions of Dr. Valin's paper were these: "That the vitality or growth of these mineral organisms consists in the passage of a crystal into a colloid, and is thus correlated, but not identical, with the kinetic process known as crystallization. That the molecule of the bodies consists of many elements, and that acid and alkaline polarities are always concerned in their growth, for only acid minerals in alkaline solutions gave rise to them. That we have a right to suppose that living protoplasm is nothing but a highly complex mineral organism in favorable media (water and air)."

This would tend to confirm the growing belief among biologists, that life is nothing but the energy manifested by the forty and odd (Reinke) proximate principles which constitute protoplasm, when they pass from the crystalline or soluble into the colloid state in the proper media.

In the brief discussion which followed, Dr. Clevenger asked the writer whether he believed that the growth of these minerals might not be dependent on the action of some micro-organisms.

Dr. Valin answered that some micrococci had been seen in the solutions used, and that a large fungus at one time covered the surface of the water in one flask with its mycelium, visible to the naked eye. But as the minerals referred to grow instantaneously in any kind of water, and as this water remains transparent, it excluded the possibility of any bacterial action.

The question was the more pertinent, however, as Alphonse Wurtz, the great chemist, made a communication to the Académie des Sciences, not long ago, in which he described a vibrion which is always found in certain germinating seeds, as that of Indian corn. It seems that this micro-organism is indispensable to the process of germination and that its role consists in eating into the outer coat of the seed, which thus becomes permeable to water.